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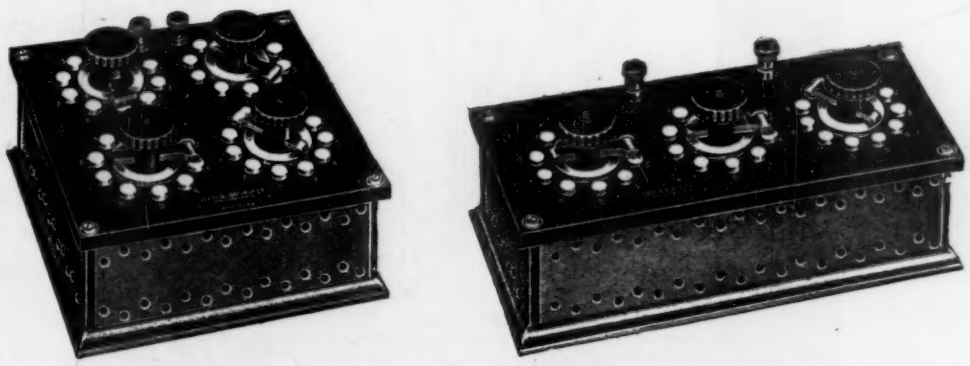

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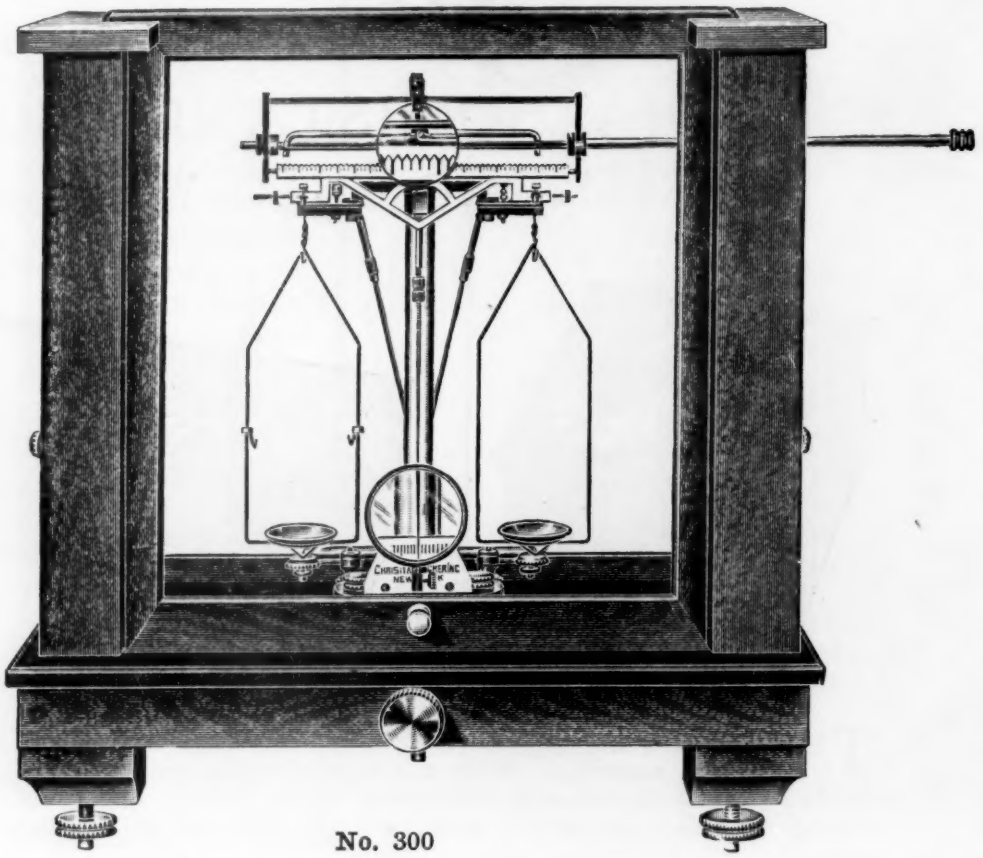

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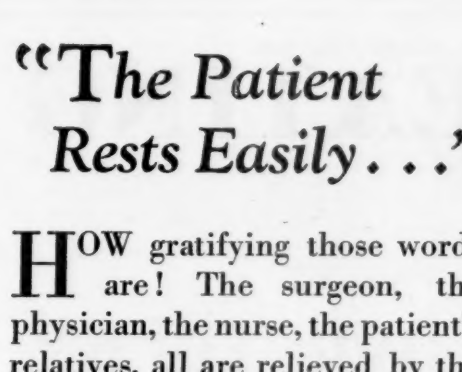

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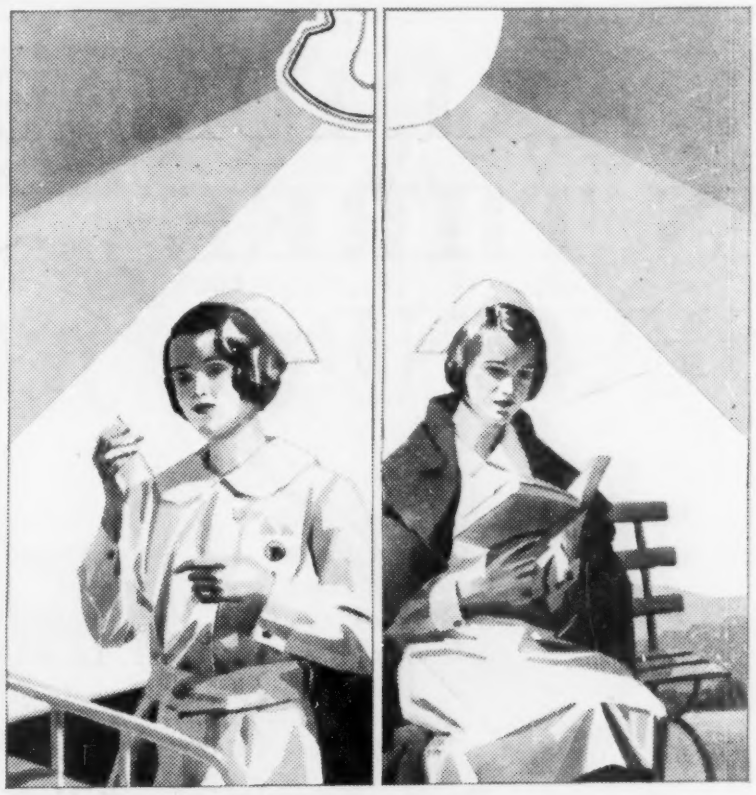

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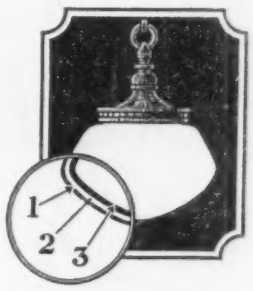

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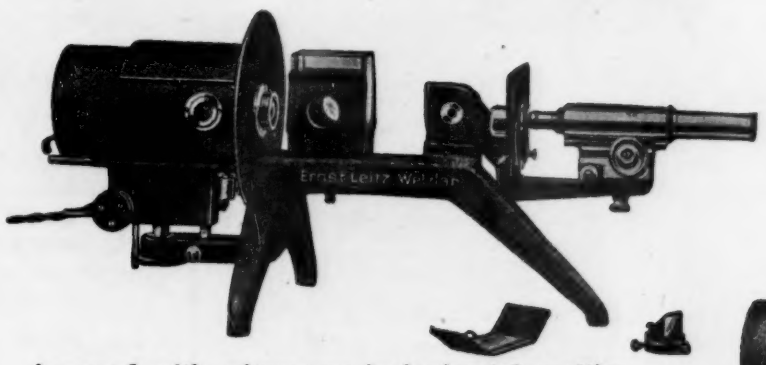

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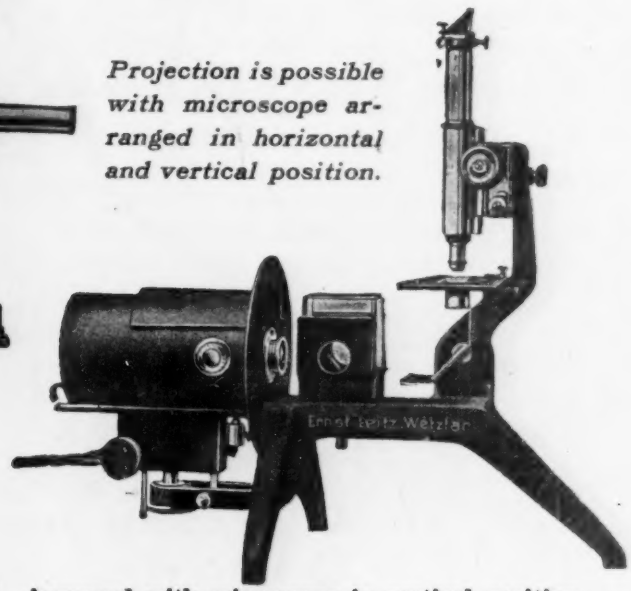

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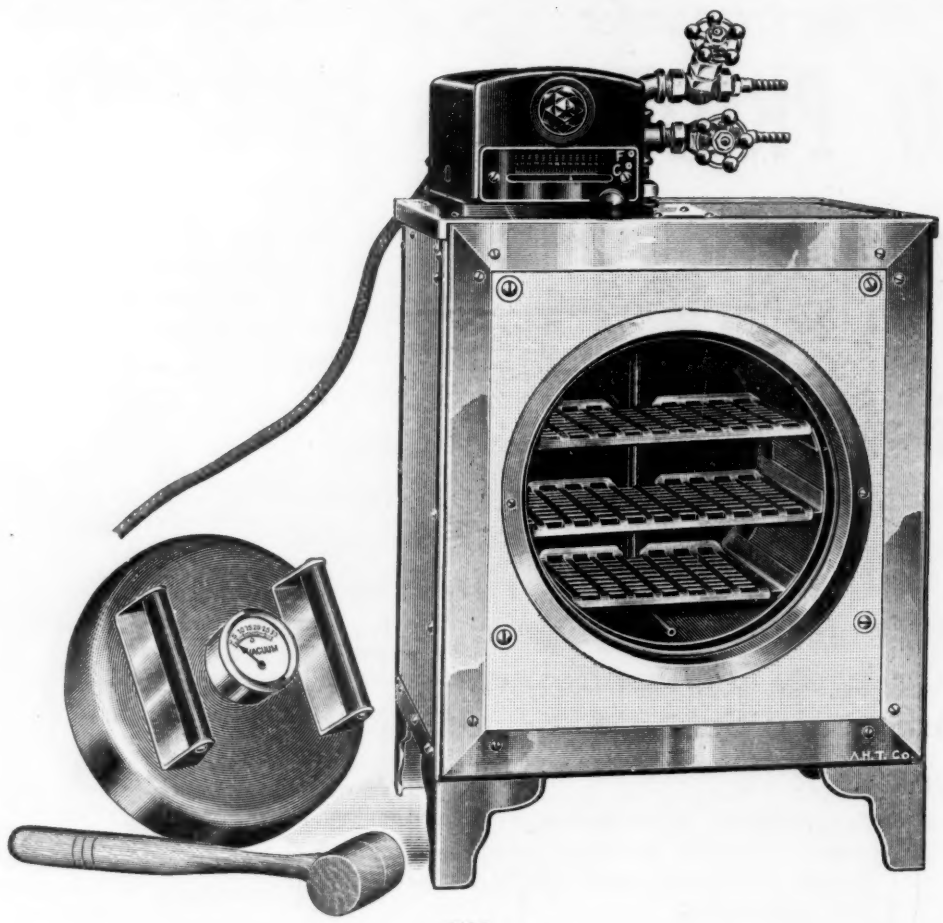

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ANATOMY AS A SCIENCE[1]

By Professor S. R. DETWILER

COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY

ON behalf of the College of Physicians and Surgeons, which I have the honor of representing to-day, I wish to extend to you, the members of the first year class in medicine, a most hearty welcome.

Since I have the privilege also of representing on this occasion the newly organized department of anatomy in this institution, and since, in the course of a few days, you will be actively engaged in anatomical studies, I thought it might not be inappropriate for me to speak to you about the subject of anatomy, with respect to a few of its past developments and to its present status amongst the biological and medical sciences.

[1] Address delivered at the opening exercises of the College of Physicians and Surgeons, Columbia University, New York, September 25, 1929.

In the preparation of this address I have drawn freely from the following sources: R. G. Harrison, "Anatomy; Its Scope, Methods and Relations to Other Biological Sciences," *Anat. Record,* vol. 7, 1913; W. A. Locy, "Biology and Its Makers," Henry Holt and Company, 1910.

An anatomical laboratory is no doubt frequently thought of as a place characterized by the presence of a morgue and large vats filled with formalin-soaked specimens; a place where boxes of rattling bones reside upon shelves to be doled out to beginning students in order to revive their powers of memory which they may have largely lost during the more or less care-free activities of their academic careers.

Based upon the experience of others, it may be regarded as a place where thousands of tedious facts must be learned and later forgotten before the gratifying emoluments attending the practice of medicine may be fully realized.

An anatomical laboratory does possess what I have mentioned—a lot of dead things—but if this were all that characterized the place, anatomy as a science would be as dead as the cadaver which is placed at your disposal in order that you may hack out the necessary morphological slices preparatory to the practice of surgery.

Anatomy is very old. Throughout the ages it formed the keystone around which systems of medicine were elaborated. As far back as the reign of the Yellow Emperor, Huang Ti, over two thousand years before Christ, anatomical charts were assembled which formed the basis for the curious art of needling or acupuncture which has been practiced throughout centuries and even to the present day in China. Anatomy was studied by the Egyptians, the Alexandrians, the Persians and the Greeks ages before its dawn in medieval and modern Europe.

Although the study of the natural sciences had evidently attained a high grade of development among the Greeks, it underwent steady decline in the hands of the Romans.

During the Middle Ages the science of anatomy as well as all other natural sciences sank to an amazingly low level. One of the chief causes which was responsible for the cessation of scientific thought and investigation was the dominance of the priesthood in all intellectual as well as in spiritual life. The world-shunning spirit of the early Christians developed an attitude which was hostile to observation. As a result, the observation of nature came to be looked upon as proceeding from an impious curiosity. The priests who had access to the books assumed direction of the intellectual life. They were largely employed with the analysis of the supernatural, without the wholesome check of observation and experiment. Consequently, mythical explanations were invented for natural phenomena, and metaphysical speculation became the dominant form of mental activity.

A very striking characteristic of science in the Middle Ages was the great reverence for authority. In this atmosphere controversies over most trivial points were fostered and the ancient writers were quoted as sustaining one side or the other. All this led to the referring of questions, as to their truth or error, to authority as the source of knowledge. It was an epoch of great importance, therefore, when men began again to observe natural phenomena and to trace the relation between cause and effect in the universe.

In this uncongenial atmosphere men like Vesalius, Descartes and Galileo established the new movement and overthrew the reign of authority. This was particularly striking in the field of anatomy where Vesalius overthrew the authoritative reign of that supposedly great anatomist, Galen, which had lasted for twelve centuries.

The way in which anatomy was taught in the Middle Ages was characteristic of all science teaching of that period. Instead of being taught by observation, the writings of Galen were expounded from the desk, frequently without demonstrations of any kind, and his work came to be recognized as the unfailing authority on anatomical knowledge. Just as the scriptures were accepted as the unfailing guide to the spiritual truth, so Galen and other ancient writers were made the guide to scientific truth and thought.

A successful revolt against slavery to authority in anatomy was accomplished largely through the efforts of that great anatomist of the sixteenth century, Vesalius. The story is old, but nevertheless striking, which relates how Vesalius, as a student at his third lecture in anatomy in the amphitheater of Sylvius, pushed aside the clumsy surgeon barbers who did the dissection and himself exposed the parts of the body as they should be. He could not be satisfied with the writings of the printed page, but must grasp through his own handling the facts of anatomical structure. And it is said that when he later began to teach anatomy, he would not intrust to the ignorant barbers the task of laying before the students the secrets of the human body, but with his own hand he unraveled the structures with which he was dealing. He employed Galen's writings, but the body on the table disagreed with what Galen had written, so he eventually cast Galen's writings aside and taught only what he himself could see and what he could make his students see. Thus he brought into anatomy a new spirit, and scores of students attended his lectures and demonstrations. For five years Vesalius labored ardently disentangling the pattern of the human body, trusting to words of no master, and at the end of five years he published a monumental work entitled "The Structure of the Human Body," which created an epoch in the progress of science.

With this very sketchy historical account of a period in the development of anatomy, let us pass on to some more recent considerations of this subject. Situated as it is, its scope overlaps that of many of the other biological sciences, not to mention its important applications in medicine and surgery. The greatest danger to anatomy as a science, however, as was pointed out by Harrison more than fifteen years ago, lies in the very fact of its practical importance. It was this circumstance—particularly in England and America—that threatened to make the science entirely subservient to practice. In any quarter where anatomy is viewed solely as a handmaid to surgery it becomes robbed of that quality which makes any science living, namely, science for its own sake. But with the long background which anatomy has had you may ask, "What is there left for the anatomist to do, since in the past centuries all the details of the human frame and its variations have been carefully worked out and are available for study in the numerous textbooks and atlases which adorn every dissecting room?" In response to such a hypothetical question I would cite a paragraph from Sir William Osler's "Leaven

of Science," which was an address delivered at the opening of the Wistar Institute of Anatomy at the University of Pennsylvania in 1894. Osler cites the following story, told by Sir Robert Christison, about Barclay, one of the leading anatomists of the early part of the nineteenth century. Barclay spoke to his class as follows:

> Gentlemen, while carrying on your work in the dissecting room, beware of making anatomical discoveries; and above all beware of rushing with them into print. Our precursors have left us little to discover. You may, perhaps, fall in with a supernumerary muscle or tendon, a slight deviation or branchlet of an artery, or, perhaps, a minute stray twig of a nerve—that will be all. But beware. Publish the fact, and ten chances to one you will have it shown that you have been forestalled long ago. Anatomy may be likened to a harvest field. First come the reapers, who, entering upon untrodden ground, cut down great stores of corn from all sides of them. These are the early anatomists of modern Europe, such as Vesalius, Fallopius, Malpighi and Harvey. Then come the gleaners, who gather up ears enough from the bare ridges to make a few loaves of bread. Such were the anatomists of last century—Valsalva, Cotunnius, Haller, Vicq d'Azyr, Camper, Hunter and the two Monroes. Last of all come the geese, who still contrive to pick up a few scattered grains here and there among the stubble, and waddle home in the evening, poor things, cackling with joy because of their success. Gentlemen, we are the geese.

And, as Osler says,

> Yes, geese they were, gleaning amid the stubble of a restricted field, when the broad acres of biology were open before them. Those were the days when anatomy meant a knowledge of the human frame alone; and yet the way had been opened to the larger view by the work of John Hunter, whose comprehensive mind grasped as proper subjects of study for the anatomist all the manifestations of life in order and disorder.

With the long background which anatomy has had, it has not advanced nearly as rapidly as many of the other biological sciences. This may be due in part to the restricted sense in which anatomy has been viewed, but more probably to the failure of the anatomists to employ earlier, experimental methods. It is clear to every one, I believe, that the sciences which have employed experimental methods have advanced by leaps and bounds over those in which phenomena have been studied merely as nature presents them.

Anatomy, however, has accomplished great things in the past. "By giving us a definite knowledge of the arrangement of the parts of the human body, it has done more than any other science to banish superstition and mysticism from medicine." In providing us with the concept of homology or of morphological equivalence it has brought order out of chaos. In the cell theory with its modifications it has made a generalization of first magnitude in giving a descriptive term applicable to all parts of all organisms, and it has made great achievements in the field of development.

The method of "comparative anatomy" which has been in vogue for decades has yielded the great generalization of "homology" or similarity of plan in the structure of organisms, and comparative embryology has shown a similarity in the mode of origin. Whereas the comparative method has rendered great service in the past, it has done little to reveal causal relations. With all the efforts devoted to the study of comparative anatomy and embryology, the dynamics underlying development and the production of organic form were left practically uninvestigated, and they present to us to-day problems which can be approached only by the experimental method. Problems of organic form are problems of the anatomist. Since organic form is the product of protoplasmic activity, the problems dealing with organic form must find their ultimate solution in the dynamics of living matter. Fortunately anatomists are coming to realize this more and more, and the science, which was first investigated by means of the scalpel and later by the microtome, is now in the hands of various instruments of experimentation, and can truly be said to have passed from a science of statics to one of dynamics. Consequently, most modern anatomical laboratories are no longer characterized solely by the presence of cadavers, formalin-preserved specimens and bone boxes, but with such pieces of physical and physiological apparatus as are necessary to an experimental study of the dynamics of living organisms as they bear upon the problems of organic form and function.

In stressing the importance of the experimental method in anatomy, we would not belittle many important facts which have been discovered by observational methods. There may be many uncritical experiments the results of which lead nowhere, whereas carefully weighed observations may lead to highly important results. Furthermore, many subjects are not directly amenable to experimentation, such as anthropology and others. Yet we know that, in general, the conditions in nature are so complex that many phenomena can not be resolved, whereas through experimentation, which provides for a controlled variation of conditions, effective analyses are much more readily made.

In this connection I should like to cite to you a case in which a critical experimental analysis led to the solution of a very fundamental problem in anatomy that had been studied rigorously by many noted anatomists for three score years and ten by observational methods without convincing results. I refer to

the solution of the mode of origin of the nerve fiber. When the cell theory was established, neuro-histologists set for themselves the problem of ascertaining the genetic and morphological constitution of the nerve fiber in terms of the cell doctrine. A three-cornered controversy arose which was waged for seventy-five years, now in favor of one party, now in favor of another, but at no time set to rest by unanimity of opinion. The ablest anatomists of Europe, including such men as Schwann, Balfour, Wilhelm His, Ramon y Cajal, Bethe and many others, tried by observations upon the developing embryo to show whether a nerve fiber is a product of many cells or whether it represents a protoplasmic outgrowth of a single cell. With the aid of remarkably fine methods of histological technique and with the most critical powers of observation which these men possessed the problem could not be solved to the complete satisfaction of all parties. In 1905 Herman Braus, a noted German anatomist, used the method of embryonic tissue grafting as a means of solution. This method had been employed previously in experimental problems by Harrison of this country. Although the experiments by Braus were ingeniously carried out, his interpretation of the results was soon after shown by Harrison to be incorrect. Harrison repeated the work of Braus under more critical circumstances and was able to produce powerful evidence foreshadowed in the work of His and Cajal that the nerve fiber is a protoplasmic outgrowth of the embryonic nerve cell. But there were still doubters as there always are. In order to place this discovery beyond the doubt of the opposers, Harrison invented tissue culture or the growth of tissues outside the body. He placed living embryonic nerve cells in clotted lymph on a microscopic slide, sealed the preparation against bacterial invasion and placed his preparation upon the stage of a microscope. There he was not only able to see with the eye the nerve fiber growing out from the cell as a protoplasmic extension, but he was able to measure the rate of growth. This critical experiment has had far-reaching results. It provided the basis for a definite concept of the genetic and structural architecture in the nervous system which has been of immense importance to neurology and the associated sciences, psychology and psychiatry. Furthermore, it was the beginning of a new method in the biological sciences, *viz.*, tissue culture, which is now extensively employed in nearly every research institution which aims to study cellular physiology.

If time were to permit I could cite to you other examples of the important results that have been attained by the critical usage of the experimental method. The importance of this method in the study of problems in endocrinology is a matter which you will hear of first hand from my colleague, Professor Smith, who has done such brilliant work in this field.

Medicine is no doubt headed towards the stage of exact science, and its ultimate success lies not in the treatment of symptoms, but rather upon the cooperative investigation of causation. Every patient is a research subject and every malady a research problem. The intelligent study of cause and effect in diseased organisms must be preceded by a working knowledge of cause and effect in the production of normal or essentially normal organisms. Medicine is thus demanding more and more the cooperative efforts of all scientists who venture to inquire into the matter of causation in the biological world. As a result, departmental barriers are rapidly crumbling save perhaps for the purposes of administration. Consequently, we find bacteriologists working under the roof of surgery, neurologists in obstetrics, physicists in general biology, chemists in anatomy or pathology and so on.

During your first year in medicine much of your time will be consumed in the study of the human body in the more restricted sense, as a background for pathology, medicine and surgery, and you will have little time yourself to indulge in the scientific end of the subject. We hope, however, that the present staff in anatomy will be able to present matters to you with a view-point that will make the subject of anatomy living in spite of your necessary occupation with a dead organism.

Whether you become an anatomist, a bacteriologist, a surgeon or a practitioner of general medicine does not concern us so much as does our desire to give you your morphological training in such a way that you will pass on, not only with a dynamic concept of anatomy, but with an acquaintance and appreciation of the methods in biological investigation which you will later use as necessary instruments in your endeavor to advance the field of medicine.

SYMPATHETIC MAGIC IN MODERN GUISES

By Dr. KNIGHT DUNLAP

THE JOHNS HOPKINS UNIVERSITY

FROM the earliest ascertainable periods of human activity and thought the assumption that a cause in some simple way resembles its effect has been the great obstacle to progress. Of course, the terms, "cause," "effect" and "resemblance" *may* be defined in such a way that the assumption is true, but the

terms are here to be understood in accordance with the popular usages on which the formulation of the assumption is based. In so far as man tries to control the course of nature (an attempt which is always his ultimate goal) this assumption gives rise to what the anthropologists designate as *sympathetic magic.* In order to facilitate the capture of game the savage carries out operations which, in a pictorial way, are like the capture. To facilitate the fruiting of his orchards and fields primitive man performs coitus at times and places which seem to him appropriate. To afflict his enemy the savage makes an image which resembles the enemy, and pierces, burns or otherwise maltreats it.

The early history of medicine is honeycombed with sympathetic magic. Parts of a strong animal make the eater strong. Plants which in leaf, root or fruit resemble human organs are supposed to affect those organs in helpful or harmful way. In more modern times homeopathy was based on the assumption that drugs producing the symptoms of ailments were effective in curing those ailments. Popular superstition to-day includes a multitude of sympathetic magical therapies, from the tying of a red string around the neck to prevent nosebleed to acceptance of the doctrine that believing that one is well makes him well, and that confidence in one's ability bestows the ability.

In anthropology itself the dependence on analogy has exercised disastrous effect. The most striking instance of this kind, of course, has been the assumption that a primitive design or form which resembles or represents (to the anthropologist) some object or situation, represented it for the primitive mind, and was the cause lying behind the production of the object. Artifacts, for example, which in a loose way resemble the sex organs were assumed to have been produced for that purpose, regardless of any actual historical evidence. Anthropology has freed itself largely from this blight, although the tendency of certain schools to assume that cultures resembling certain other cultures must stand in the direct relation of cause and effect is evidence that sympathetic magic is not entirely renounced. The Freudians, however, took over the magic system which the archeologists discarded and made it the basis of their symbolic interpretation.

The Freudians, perhaps, have made more use of analogy than any other modern group. After all, the "repressed desire" (or the "complex" or whatever term is currently fashionable) is a fictitious entity constructed on analogy from the symptoms of the patient, like the wax image of his enemy which the savage constructs, or like the picture of the speared animal which the primitive hunter made to aid his hunting, and the removal of the "repressed desire" is literally an operation in sympathetic magic.

The strength of sympathetic magic doubtless lies in the fact that sometimes the cause does resemble the effect (still following the common usage of the terms). The omnipresent tendency to generalize widely on a few cases, whether these cases are exceptional or not and regardless of the superficiality of the resemblance, continues to be the bane of science as well as the foundation of superstition. The upward progress of science depends very largely on the success with which it excludes analogy from its inferences, however much it may be interested in the analogies themselves.

At the present time the most pernicious form of sympathetic magic, from the point of view of science, is that which afflicts some phases of genetics. The efforts to demonstrate the "transmission of acquired characters" which have so far been made seem to be based altogether on analogy of cause and effect, and in so far as these efforts are really directed towards the ultimate control of heredity they are phases of sympathetic magic.

The question whether or not the environmental forces working upon an animal do or do not affect its progeny is not really involved here. The important point is that those who have attempted to prove the effects of environment genetically have uniformly proceeded to search for the "transmission of acquired characters," that is, for effects which shall resemble the causes. Now it is not impossible that in certain cases effects may resemble causes, but the antecedent probability of such resemblance must, in any given case, be exceedingly small. When working with any given cause, therefore, searching merely for effects which resemble it is a foolish limitation of the quest, which renders the probability of success practically negligible.

Let us take an illustration. It has been believed that if parents engage systematically in intellectual pursuits of certain kinds their activity may affect their progeny. There is nothing foolish in this assumption *per se.* It is, in fact, a hypothesis which may be experimentally useful. But the effects, and the only effects, which have been postulated by the neo-Lamarckians are effects resembling the causes, namely, increased intellectual efficiency of the same kind on the part of the progeny. This is indeed an assumption which has only an infinitesimal probability of accuracy.

To investigate the responses of mice to a dinner-bell through examination of the progeny of the mice or the responses of rats trained in a maze through examination of their progency may be a sensible scientific procedure. But to assume that any par-

ticular characteristic of the animals may be affected by the "training" of their ancestors, and to look for nothing else, seems a sterile procedure. Antecedent to the discovery of specific mechanisms through which specific effects may be "transmitted," a change in the diameter of the vibrissae of the rodents or of the coloration of the skin is just as probable an effect as a change in some detail of behavior. The chances of positive results are (if I may use an analogy merely for illustration) of the order of the chances of discovering a penknife lost in a ten-acre field by making a chart of the field, and then stabbing blindfold at the chart with a pencil. Scientists generally may well be expected to be uninterested in any such attempts.

That characters are "transmitted" in certain specific cases, namely, where certain characteristics of unicellular animals are concerned, Jennings has demonstrated. This search was useful because there an antecedent probability of the resemblance of cause and effect was revealed through expert knowledge of the genetic mechanism. With the higher animals no such mechanism has been discovered. The protection of the germ-cells is such that chemical factors alone can affect them, and there is an enormous gap between means to the production of a chemical effect in the body of the parent and the particular result which the chemical change will have in the germ-cells. Ultimate study of the chemistry of vital processes may in time indicate the effects of certain substances on the germ-cells, but there is as yet no body of information on that point, or on the chemical changes in the parent organism produced by various environmental factors and by bodily activities, competent to furnish the least basis for prediction.

There is, however, an aspect of the search for the "transmission of acquired characters" which is frequently overlooked, but which needs emphasis. The suggestion that such transmission may occur is drawn, in modern times at least, from the scheme of animal evolution. A simple and easy explanation of evolution is provided by the assumption that the adaptations an animal is forced to make to its environment affect, in some mysterious way, the structure of the animal's progeny, so that less individual adaptation is needed on their part. The postulate of sympathetic magic is here drawn upon to fill an embarrassing logical gap in biological theory. Most Lamarckians, apparently, are willing to stop here, but not all are so timid. If this is the true explanation of evolution, then there are superphysical causes at work in the world—causes of which science takes no cognizance. This is the implication of the "transmission of acquired characters" which most Lamarckians would glady deny, but which, in fact, is the real justification of their efforts.

If the mechanism of "transmission" is not through channels which can be accounted for in terms of chemistry and physical chemistry, then there are (if "transmission" is a fact) forces or entities at work which do not operate in the physical realm. If the "transmission of acquired characters" should be demonstrated for the higher vertebrates, we should be obliged to reconsider the subjects of divine intervention, telepathy and the whole gamut of "spirit manifestations" from a new point of view. Moreover, we should be obliged to admit that there is an actual foundation for the popular belief in sympathetic magic.

We admit that superstition always has its bases, although these bases are usually not such as would be easily recognized. Hence, psychologists and others have commonly lent an attentive ear and given largely of time and energy to alleged phenomena of the occult. The uniformity with which these phenomena vanish into thin air when subjected to investigation by rigorous laboratory methods has convinced us finally that there is nothing of value to be obtained in this direction. The "transmission of acquired characters" is, however, of a different order. The rats and rabbits are available in unlimited numbers. They do not refuse to work when their methods of procedure are uncovered. Experiments carried out in one laboratory can be repeated in others. This, then, is the obvious direction of work for those who are interested in the problem of a "supernatural" (or infranatural or endonatural) world. The skeptical scientists should not by any means discourage or scoff at these efforts. On the contrary, they should encourage and facilitate the investigations, for either positive or negative results are of value. But the investigations should be carried out with the cooperation of skeptics and under the observation of more than one technically qualified person. There is little use in guessing at flaws after results are reported.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

LIFE MEMBERSHIP

A LARGE portion of the permanent endowment of the American Association consists of the fees that have been paid by life members, which constitute a fund that is kept permanently invested by the treasurer, only the income therefrom being available for

appropriation by the council. The life-membership fee, which was formerly $50, has been $100 since January 1, 1920, when the annual dues were increased from $3 to $5. On September 30, 1929, the life-membership fund amounted to $44,250, from 663 life-membership payments. For the association year closed on the date just mentioned the treasurer's income from this fund was about $2,126, against which is to be charged the three-dollar journal subscriptions for 453 living life members, leaving a balance of about $767 available for appropriation. This available balance increases from year to year, through the receipt of additional one-hundred-dollar fees and through the decease of life members, for each one-hundred-dollar fee now pays an annual income of about $4.80, and journal subscriptions are of course paid only for living life members. Many fifty-dollar life memberships are still active, and the annual income from these alone is not sufficient to pay for their journal subscriptions.

It is clearly to the advantage of the work of the association that annual members should become life members, although the amount of the annual dues is at present somewhat greater than the annual income from the one-hundred-dollar life-membership fee, for this income is to continue in perpetuity and the payment of annual dues ceases with the resignation or death of the annual member. The present financial relations between the two kinds of membership are shown below, it being understood that the three-dollar payment for the journal subscription has been deducted in each case.

For the period:	Net annual income, available for appropriation, from: Each annual member (paying $5 dues)	Each life member (paying $100 fee)
Before resignation or decease	$2.00	$1.80
After resignation or decease	——	$4.80

A cursory examination of the recently published list of members (Part II of the Summarized Proceedings of the American Association for 1925–29) suggests that our roll of life members might be greatly increased if the serious attention of all annual members might be attracted to this means of aiding the advancement of science throughout the indefinite future. In the association year that closed September 30, 1929, there were enrolled forty-eight new life members, an unusually large number in our records, but nevertheless remarkably small when we consider that the total number of members in good standing at the end of that association year was 17,520 and that 2,992 persons had joined the association in the year. Only about 2.46 per cent. of the members in good standing were life members on September 30, 1929. There must be thousands of annual members whose mental attitudes and economic circumstances might be expected to lead them to become life members if they were to consider this suggestion from all sides.

Not all of the life-membership fee of $100 is to be reckoned as an out-and-out gift and nothing else, for life members really gain in several somewhat intangible ways and they do receive actual money value from the association in return for their contributions. They have the satisfaction of having inaugurated their share of the permanent endowment. Their names are specially designated in the published list of members. The complete roll of life members is kept separate from the regular current roll and is separately published from time to time. They have made it certain that their names will remain on the membership list throughout their lives and on the special roll in perpetuity. They are entirely freed from the trouble and responsibility of making a remittance each year but they are assured that the membership journal will continually come to them as long as they live and that they will have all the privileges of membership throughout their lives.

On a financial basis it is easy to show that life members receive from the association considerable returns for their one-hundred-dollar payments. They each purchase a perpetual annuity for the association, but they do so at a much reduced rate because of the fact that each life member has a life interest in the endowment fund and receives as an annuity for his life period the equivalent of the regular annual dues. But membership with the membership journal is worth more to a member than the amount of the annual dues, for the regular subscription price for SCIENCE is more than an annual member pays for both membership and journal together. A life member therefore receives annually from the association the equivalent of much more than $5 a year. It is safe to say that he gets more than the equivalent of interest at 6 per cent. on the life-membership fee although he has contributed to the association the principal of the fee. While both annual members and life members contribute to the available funds of the association throughout the period of membership and throughout life, respectively, and although the amount thus annually contributed by an annual member is actually a little larger than the annual income received by the association from the life membership fee, yet we must remember that the ultimate contribution of a life member is unlimited.

From the standpoint of actuarial probability and banking discount, the cost of life membership to the life member and his prospective estate is somewhat greater than the present cost of annual membership, but the difference may be accounted for (without reference to philanthropy) by the fact that the life member has purchased the assurance that his membership, with the journal subscription, will be continued as long as he lives. On a strictly financial basis a life membership of about forty-one years' standing is, at present, a clear asset to its holder and to his prospective estate. If an annual member were to establish an invested fund of $100 with average interest of 4 per cent., allowing the interest to be always added to the principal and paying from the fund the annual dues of $5 each year, the fund would not be used up till the forty-first year. After that year, if such a careful member were to continue his annual membership, it would be necessary for him to find other funds with which to pay the annual dues from year to year.

Attention needs to be drawn, however, to still another consideration, which is in favor of the life member as compared with the annual member; namely, that the annual dues are much more likely to be increased than to remain at their present magnitude. As every one knows, they are now exceptionally low, when they and the association journal are compared to the dues, journals, etc., of other similar organizations, and it is highly probable that the annual dues of the American Association may be increased in the near future. When this occurs it will of course have no effect at all on the financial relations of those who are life members at the time; it will make no difference to them whether the annual dues or the life-membership fee may or may not be increased. It is probably a safe prediction that the annual dues will never be decreased.

In some few instances it is necessary for an annual member to allow arrearage to accumulate and the names of such members are carried on the association roll until arrearage amounts to two years. Life membership offers a special attraction to those members. Of a total enrolment of 18,462 on September 30, 1929, there were 327 names in arrears for two years (these were dropped from the roll on the following day, October 1) and 615 names in arrears for one year (these names are to remain on the roll till October 1, 1930, when they will be dropped unless arrearage, or at least back dues for one year, shall have been paid in the meantime). (Note, however, that these annual members in arrears are not in good standing and that the membership journal subscription is discontinued when arrearage amounts to four months.) According to a special ruling of the council, any annual member in arrears for less than two years may be reinstated and may become a life member by paying the life-membership fee. Life membership begins with the year in which the fee is paid and the fee may be paid at any time before September 30, which is the last day of the fiscal year of the association.

It should be mentioned also that an annual member who has paid the dues for the current year may have them refunded when he pays the life-membership fee. New members may have the entrance fee ($5) remitted if they become life members when they join.

It is desirable that a sort of campaign for increasing the number of life members of the association should be carried out from time to time, and such a campaign is to be a feature of the present association year. How many new life members will be enrolled before the opening of the Des Moines meeting?

BURTON E. LIVINGSTON,
Permanent Secretary

OBITUARY

JOHN STERLING KINGSLEY

DURING the late summer of 1929, the many friends of Dr. John Sterling Kingsley were shocked to learn of his death and burial at sea. In company with his daughter, Mary, he had undertaken a trip around the world which, as he wrote to friends, was to be his "last great adventure." It was indeed that in a deeper sense than he realized. His death occurred on the steamship *President Taft* when three days out of Yokohama and was probably due to an aortic stenosis. He was found in his berth with an open book and his light turned out.

A year ago, when he was considering whether or not he could attend the Zoological Congress in Padua in 1930, he wrote that "finances and my strength are the principal questions. But don't think from this that I am weak, for I am in the best of condition." He evidently overestimated his strength, and his death at the age of seventy-five removes a well-known and much-loved personality from our midst.

John Sterling Kingsley was born at Cincinnatus, New York, on April 7, 1854. Two years after his birth the family moved to Norwich, the county-seat of Shenango County, where his father presided as judge over the County Court. Kingsley's early education was received in the private academies of Cincinnatus and Norwich. At the tender age of twelve his scientific bent was manifested in the publication of a weekly chemical journal of which he was both owner and editor.

After receiving special training in engineering subjects, he was given an appointment to the U. S. Naval Academy at Annapolis. Declining this, young Kingsley entered the Brooklyn Polytechnic Institute. There, however, his studies were interrupted by the death of his father. Being compelled to earn his living, he began service as "head chain" on the Delaware, Lackawanna and Western Railroad, ending finally as transit man on the Utica, Chenango and Cortland Railroad.

After a year and a half of this employment he was able to enter Williams College in 1873 as a member of the junior class. His inclination toward the medical profession led him while carrying on the regular studies of his college course to master Gray's "Anatomy" and to dissect parts of the human body. As a member of the Natural History Society of Williams College, however, his interest in natural history became aroused, and before his graduation he had decided to become a zoologist.

After graduation in 1875, he went to the Peabody Academy of Science at Salem, Massachusetts, in order to begin the study of insects under Dr. A. S. Packard. At that time not a single American college maintained graduate courses in zoology, and an ambitious student such as Kingsley was obliged either to study in European universities or to get instruction from some working zoologist like Packard. The following year he was appointed curator of the Peabody Academy at Salem and held the position for two years. In 1875–79 he assisted in the work of the U. S. Entomological Commission. During this period a number of scientific papers, mostly systematic, were written, some of them descriptive of Crustacea. But in 1879, going to the Philadelphia Academy of Natural Sciences, he began his first studies in morphology.

Throughout these study years, Kingsley was self-supporting. To this end he utilized his exceptional gifts as an artist. He made his living expenses by drawing illustrations for scientific books, journals and reports, as well as diagrams for lecture illustration. Occasionally he was paid by some journal for contributions upon scientific subjects. By such apprenticeship in thrift Kingsley prepared himself for his life as a college professor. However small his salary, and he never received a large one, he was always able to save.

In 1881 he became the curator of the Worcester (Massachusetts) Natural History Society, a position which he retained for one year. Resigning from this, he was made the editor of the new "Standard Natural History."

As the editor of the "Standard Natural History" from 1882 to 1885, Kingsley acquired a general reputation in the scientific world. Parts of the six volumes he wrote himself. His marriage to Mary Emma Read, of Salem, came at the beginning of this editorship.

Enrolling as a graduate student in Princeton University, he received from the College of New Jersey in 1885 the degree of Sc.D. His thesis on the "Embryology of Limulus" was published in England by Ray Lankester. Except for the year 1891 spent with Wiedersheim in Freiburg, this completes the period of Kingsley's formal education.

His career as editor, however, was not finished with the publication of the "Natural History." From 1886 to 1896 he edited the *American Naturalist*, which remained for many years the leading natural history journal in America. Still later—from 1910 to 1920—he served as editor of the *Journal of Morphology*. His long editorial experience combined with a retentive memory gave Kingsley a broader and more intimate acquaintance with zoological literature than is possessed by most professional zoologists.

Kingsley was an inspiring teacher, and his experience was long and varied. From 1887 to 1889 he was associated with Starr Jordan and Eigenmann in the University of Indiana, and he often referred with enthusiasm to his association with those distinguished zoologists.

The following two years he spent in the University of Nebraska, where he became dean of the faculty. Then, after a year's study abroad, he accepted a professorship at Tufts College, where he remained for twenty-one years. For some years in this institution he was dean of the graduate school. He resigned from Tufts in 1913 to accept a professorship of zoology in the University of Illinois. In 1921 he retired from active teaching to spend his last years at Berkeley, California. Even then he was not idle. Professor Kofoid writes that "Dr. Kingsley quickly established connection with the department here on his coming to Berkeley to live. He had a desk in one of our research laboratories and made himself most friendly to our graduate students and staff in many helpful ways. He contributed constantly to the work in our seminar and was a fine influence in the direction of scholarly work in our graduate group."

Kingsley was a member of many scientific societies such as the Zoologists, Anatomists, Naturalists, the Anatomische Gesellschaft, Zoological Society of London, the American Association for the Advancement of Science, etc.

He was president of the American Society of Zoologists in 1908 and vice-president of Section F of the American Association in 1920.

In addition to several hundred scientific papers published in various journals, Kingsley wrote a number of important text-books such as "The Elements of Comparative Zoology," 1896; "Vertebrate Zool-

ogy," 1899; "Guides for Vertebrate Dissection," 1907; "Comparative Anatomy of Vertebrates," 1912, 1917; "The Vertebrate Skeleton," 1925. In the translation of Hertwig's manual of zoology Kingsley rendered an important service to zoological instruction in America. While it is the custom of some zoologists to decry text-book writing one can not read Kingsley's texts without realizing that a good deal of independent research entered into them. This is especially true of his book on the "Vertebrate Skeleton," which is a masterly work and will remain for many years a standard reference in osteology. Most of this book was written after Kingsley's retirement from teaching. Undaunted by the loss of the drawings for this book in the great Berkeley fire, Kingsley duplicated the entire set in an incredibly short time and the book was published without great delay. This illustrates his exceptional capacity for concentration and prolonged intellectual exertion.

Early in his career as a zoologist, Kingsley became interested in marine biology. As a result, in cooperation with George A. Bates and S. E. Cassino, of Salem, he converted the "Garden House" on the pier at Beverly, Massachusetts, into a marine biological station. One of Kingsley's students at this station was Hermon Carey Bumpus, then an undergraduate at Brown University. Kingsley later became director of the Annisquam Laboratory, following Alpheus Hyatt and B. H. Van Vleck. During the summers of 1889 and 1890 he joined the teaching staff of the Marine Biological Laboratory at Woods Hole. Connection with this station as an instructor was broken by his year abroad as a student in Germany, and was never renewed.

Convinced of the need of a marine laboratory north of Cape Cod, Kingsley in 1898 established a summer school of biology in a small cottage at South Harpswell, Maine. Here in 1901 a new laboratory building was erected with funds raised by Kingsley himself. After its incorporation in 1913 as the Harpswell Laboratory, the station was moved in 1921 to Mount Desert Island in order to secure better financial support. Kingsley was greatly interested in this station and had planned to make it a visit in 1930 on his return from the trip around the world. The Mount Desert Island Biological Laboratory, however, remains as a monument to his memory.

Among the admirable qualities which characterized Kingsley none was more marked than his industry. For him the day's work began with the dawn, and he rarely allowed himself to be distracted from his allotted task. While in the laboratory he made frequent calls on other workers, such interludes served to refresh him for renewed exertion. He seemed indeed inexhaustible.

His capacity for friendship was notable. Few men have had as wide an acquaintance among zoologists of all countries as he had. Moreover, he was at home with all sorts and conditions of men. His friendly and kindly spirit attracted people to him. Many will recall his genial custom of gathering groups of friends together in Bohemian fashion. Such occasions were made memorable by his sense of humor and unlimited supply of anecdotes drawn from his varied experience.

His interests were broad—which serves to define him as the cultured man he was. His published papers cover a surprisingly wide range of problems. He was, however, characteristically a morphologist, and none of his published papers evidences acquaintance with the more recent experimental phases of biology. Of philosophy he usually spoke with a contempt which seems to have been engendered primarily by his college teacher of that subject.

An exceptionally large and distinguished group of American zoologists remember Kingsley as an inspiring teacher. Through his influence many students were led to take up zoology as a career. His lectures illustrated by free-hand drawings on the blackboard and enlivened by flashes of humor will be long remembered as models of lucid exposition. As a laboratory instructor he succeeded by skilful questioning in stimulating the imagination of his students. They will carry on the torch which has fallen from his hand.

H. V. NEAL

TUFTS COLLEGE

RECENT DEATHS

FATHER FRANCIS A. TONDORF, director of the Seismic Observatory of Georgetown University, died suddenly on November 29 at the age of fifty-nine years.

DANIEL MOREAU BARRINGER, consulting geologist and mining engineer of Philadelphia, died on November 30, aged sixty-nine years.

DR. ANDREW JOHNSON BIGNEY, professor of zoology in Evansville College, Indiana, died on November 13, following an illness of less than a day, at the age of sixty-six years. He gave his life to Moore's Hill College and its successor, Evansville College.

THE death is announced of Dr. Otto Krigar-Menzel, professor of theoretical physics in the University of Berlin.

Nature announces the deaths of Frank E. Baxandall, of the Solar Physics Observatory, which took place on October 30 at Cambridge, in his sixty-first year; of Sir Graham Balfour, from 1903 until 1926 director of education for the County of Staffordshire, who contributed to the progress of technical education in Great Britain, on October 26, aged seventy years; of Dr. Thomas Alexander Wemyss Fulton, superintendent of scientific investigations, Fishery Board for

Scotland, from 1888 until 1921, on October 7, aged seventy-four years, and of Sir Thomas Hungerford Holdich, president in 1916–18 of the Royal Geographical Society, on November 2, aged eighty-six years.

PROFESSOR AUGUST FRIEDRICH HORSTMANN, known for his investigations of the thermodynamics of chemical processes, has died at Heidelberg at eighty-seven years of age.

SCIENTIFIC EVENTS

RECENT ACQUISITIONS OF THE BRITISH MUSEUM

THE London *Times* reports that, through the generosity of Mrs. M. E. Eaton, the department of entomology of the British Museum has received the collection of Psychodidae (moth-flies) formed by her late husband, the Reverend A. E. Eaton, and including over 1,800 pinned specimens and about 200 microscope slides. It is probable that the Eaton collection is the largest and most important in existence, including, as it does, in addition to a complete series of the known British species, much material from Switzerland, Algeria, Madeira, the Canary Islands and elsewhere.

For thirty years before his death, on March 23, the late Mr. Eaton had made the collecting of these little flies his special hobby, paying particular attention to species connected with running water. He had also accumulated extensive notes in preparation for a monograph on the group, and it is hoped that it may be possible to publish some parts of his manuscript.

Mr. Robert B. Benson has presented 2,500 specimens of British sawflies, collected by himself; this donation includes specimens which will be made the types of species new to science, as well as to the collection, and fine series of many rare species in excellent condition.

In the department of zoology an addition to the collection of Ungulates is a fine pair of horns of the black rhinoceros (*Rhinoceros* (*Diceros*) *bicornis bicornis*), bequeathed to the museum by the late Mr. Henry Allin Martyn. The specimen was shot in Kenya by the testator, and is of exceptional interest in that the rear horn is longer than the front horn. This rhinoceros represents the Keitloa type, which formed the basis for the description of a species known as *Rhinoceros keitloa,* which has since been shown to be founded on nothing more than an individual variation.

A fine example of the common porcupine (*Hystrix cristata*) has recently been presented to the same department by the trustees of the Rowland Ward Bequest. It is mounted in a defensive attitude with its spines erected.

Mr. C. D. Soar has presented to the department a collection of nearly 600 slides of microscopic preparations of water-mites, forming the material described in the standard monograph, "British Hydracarina," by Mr. Soar and Mr. Williamson, published by the Ray Society (1925–29, three volumes). The water-mites, although little known except to amateur microscopists interested in pond life, form a group of animals remarkable for brilliancy of color and eccentricities of form. Many in this collection are remarkable examples of the mounter's art.

Additions to the department of geology include a cast and enlarged model of the tooth of the fossil man *Sinanthropus pekinensis* from the Pleistocene of China.

SCIENTIFIC STUDY IN THE ARCTIC AND ANTARCTIC REGIONS

AN Associated Press despatch from Copenhagen reports that plans are well advanced for the scientific study of Arctic and Antarctic phenomena expected to be in evidence with more than usual force during 1932–33, which will be one of the so-called "polar years" which occur only once in every half century.

According to D. B. La Cour, director of the Meteorological Institute and president of the program committee selected at an international meeting of meteorologists in Copenhagen in 1928, the globe already has been divided among the nations interested in the polar year phenomena and each nation has been assigned its sphere of study.

Denmark will have three stations in West Greenland; Holland is to have an expedition stationed at Angmagsalik, midway up on the coast of East Greenland; France will have a station on Scoresby Sound, East Greenland, where an expedition ship has already landed supplies and scientific instruments; the United States will have stations in two other parts of Greenland, and Germany will have her station at Ivigtut.

Meanwhile Australia and New Zealand are cooperating with the American investigators who are establishing several stations near the magnetic south pole. These stations will attempt to establish wireless contact with their colleagues studying north polar conditions, and the simultaneous exchange of meteorological data regarding current conditions in the north and south polar regions is expected to be of immense scientific interest.

Other stations are also planned at Spitzbergen, Novaya Semlya, Baffin Land and Point Barrow. If possible radio communication will be established between all the stations and data on phenomena simultaneously checked from many points. The personnel

of all the expeditions will spend the winter at their frozen posts.

THE NATIONAL PARKS

FOLLOWING President Hoover's lead in mobilizing the industrial and commercial interests of the country in aid of national prosperity, the Secretary of the Interior, Ray Lyman Wilbur, on December 6, opened a conference of representatives of the public utilities operating in the national parks which it is hoped will result in increasing the use of these areas by the public generally, and in promoting the expenditure of travel funds by our people in the United States rather than abroad.

The main purpose of the meetings, which are periodic and were expected to continue to the following week, is to work out, with the utility operators, methods of furnishing adequate standardized or similar service in the various parks.

In concluding his address Secretary Wilbur spoke of the educational development that is going on in the parks, saying, however, that the word educational does not quite express what the service is endeavoring to do.

"What we seriously want," he said, "is to make botany, zoology, geology and other natural sciences interesting to the people generally. We want to give them an opportunity in the parks to see just what nature is. We have got together a very interesting group of men studying the effect of the parks, which are really museums of nature, on the thinking of our people.

"The parks should be viewed as great natural resources rather than circuses where people go to have a good time in the popular meaning of the word. We find the development of this so-called educational phase of the parks is being well received by visitors generally."

The secretary also paid a tribute to the loyal support which the great western railway systems have given the government in its endeavor to popularize the parks.

In concluding, he asked the operators to consider (1) the working out of plans that will adequately protect legitimate investments; (2) how a reasonable standardization of service to the public in the various parks may be obtained; (3) means of arriving at uniform rates for similar types of service in all the parks, and (4) the prompt working out and submission to the government of plans for expansion to care for heavy travel.

A PHILADELPHIA SCIENTIFIC MUSEUM IN MEMORY OF BENJAMIN FRANKLIN

NEARLY 400 leaders of science, industry and civic affairs, according to the New York *Times*, pledged themselves on December 5 to support the establishment in Philadelphia's Parkway, as a memorial to the genius and humanity of Benjamin Franklin, of a great scientific museum, a type of institution which the German Ambassador, Baron von Prittwitz und Gaffron, declared would "do more to establish peace and progress in humanity than all the work of all the diplomats."

Completed plans for a combined museum and memorial, patterned largely after the Deutsches Museum in Munich and expected to cost about $5,000,000, were presented at a dinner given by Cyrus H. K. Curtis, president of the Benjamin Franklin Memorial, Inc., at the Downtown Club.

Described "as a place not only where learning shall be shown in its greatness and power but where learning shall be made attractive," the museum project was outlined and praised in addresses and talks made by Dr. Howard McClenahan, secretary of the Franklin Institute, which, with the Poor Richard Club, is sponsoring it; former Senator George Wharton Pepper, Owen D. Young, Ambassador von Prittwitz und Gaffron, Pierre de la Blanchetai, of the French Embassy, and Mayor Mackey.

A resolution of support, introduced by Sidney E. Hutchinson, was adopted.

A plot of ground, 350 feet square, between Twentieth and Twenty-first Streets, and valued by Mayor Mackey at about $3,000,000, has been contributed by the city as a site for the memorial, and its sponsors hope to break ground next spring. It will combine a graphic arts museum, a planetarium, a Franklin memorial chamber, museum for displays of bridges, docks, canals and industrial developments, an observatory, library and headquarters for the Franklin Institute.

Several contributions of $250,000 or more have been pledged to the project, but the total in sight has not been announced. Samuel S. Fels has provided for a Zeiss planetarium. In the astronomical section will be a Foucault pendulum shaft in which a pendulum will demonstrate the rotation of the earth and a room for the display of Ptolemaic and Copernican planetaria. It is proposed that the library will be composed of one of the finest scientific selections in the world.

ANNUAL EXHIBITION OF THE CARNEGIE INSTITUTION

ACCORDING to a news bulletin of Science Service the first monument to Captain James Ault, of the Carnegie Institution of Washington, who was killed when his ship, *The Carnegie*, was destroyed by explosion and fire in Apia Harbor, Samoa, on November 29, will consist of his own work and that of his associates, which will form a special section at the institution's annual exhibition, open in Washington from Saturday, December 14, to Monday, December 16.

The central figure of the memorial exhibit will be a large globe, on which will be traced the long wake *The Carnegie* left on the seven seas during her twenty years and more of voyaging. Further exhibits will show how the data on the magnetism of the earth gathered on these cruises have been put to use in scientific work and in the highly practical field of guiding ships safely to port. There will also be a model of the apparatus used to correct the compass determinations against the errors introduced by the roll and pitch of the ship, as well as displays of specimens, photomicrographs, microscope slides and graphs illustrating the many studies conducted by the scientific staff of *The Carnegie* on the physics and biology of the ocean and the geology of its bottom.

The annual exhibition of the Carnegie Institution attracts visitors from all parts of the country. In addition to the memorial exhibit of the work of the ill-fated *Carnegie,* there will be displays of the work of other departments of the institution.

Of especial interest will be the display of archeological specimens and photographs showing the progress of excavations in Central America and the southwestern United States. Both of these exhibits will show the airplane photographs taken by Colonel and Mrs. Charles A. Lindbergh, which have opened up an entirely new technique in the study of American antiquity.

A still greater antiquity is studied by the institution's workers in paleobotany. Examination of petrified logs from Yellowstone National Park by Dr. A. E. Douglass, using the same methods of tree-ring counting that enabled him recently to date the ancient Pueblo ruins of the southwest, has shown that the same cycles of sun-spot numbers we know to-day prevailed 20,000,000 years ago, when these forests were overwhelmed by showers of volcanic ash and sand.

Plant life in the present-day west will be graphically shown by a cross-section of a typical desert area near Tucson, Arizona. The model shows a granite mountain, a volcanic mountain, the talus slopes and outwash slopes, an undrained basin and the flood-plain of a large river, and indicates the plant associations that have established themselves on each of these soil areas.

Life on a much smaller scale will be shown by the exhibit of the work on diatom investigation. Diatoms are exceedingly minute one-celled plants that live in both fresh and salt water. There is an immense number of species of them, many of them displaying great beauty of form and markings under the microscope. They have lived in the past in such vast numbers as to form great deposits of the economically valuable "diatomaceous earth"; and those living to-day are giving esthetic inspiration to artists and designers of such various wares as dress goods and stained-glass windows.

SCIENTIFIC NOTES AND NEWS

ON the occasion of the dedication of the John Markle Mining Engineering Hall, Lafayette College conferred a doctorate of science on Dr. William Otis Hotchkiss, the dedication speaker, president of the Michigan College of Mining and Technology.

DR. G. CANBY ROBINSON, director of the new medical center of the New York Hospital and Cornell Medical College, has been made president of the Harvey Society for the ensuing year.

THE Philadelphia Pathological Society has awarded the William Wood Gerhart medal to Dr. Eugene L. Opie, professor of pathology at the University of Pennsylvania School of Medicine, who delivered the Gross lecture before the society on November 14 on "Occurrence and Spread of Tuberculosis Infection."

THE Physical Society of Pittsburgh tendered a dinner on November 21 in honor of Dr. Clinton J. Davisson, preceding his lecture on "The Wave Properties of Electrons" at the Carnegie Institute of Technology.

DR. GEORGE T. HARGITT, of Syracuse University, addressed the Biological Journal Club of the North Carolina College for Women, Greensboro, at a dinner given in his honor on November 21. His subject was "The Germ Cells of Mammals."

ON November 26 there was held at the Queen City Club of Cincinnati a dinner celebrating the twenty-fifth year as professor of biochemistry of Dr. Albert Prescott Mathews, head of the department of biochemistry in the University of Cincinnati. Some one hundred scientific colleagues, friends and students of Dr. Mathews were present. The toastmaster was Dr. Frederick C. Hicks, president emeritus of the University of Cincinnati, and the speakers were Dean Basil C. H. Harvey, of the college of medicine, University of Chicago; Dr. George W. Crile, of Cleveland, and Dr. Nevin M. Fenneman, professor of geology in the University of Cincinnati. Dr. Mathews expressed his appreciation of the honor done him and told of the early development of biochemistry in this country and the rôle it will play in the future.

IN addition to the degree of doctor *honoris causa* recently conferred on Professor Albert Einstein by the University of Paris, the degree was conferred on

Dr. Roux, professor of clinical surgery in the University of Lausanne.

M. MAURICE DE BROGLIE has been elected a foreign member of the Upsala Academy of Sciences.

AT the meeting last month of the British Institution of Civil Engineers, the Kelvin gold medal was accepted by the French ambassador on behalf of M. André Blondel, the distinguished French engineer, who was unable to visit England on account of ill-health.

DR. MOTOJI SHIBUSAWA, dean of engineering of the Tokio Imperial University, has been awarded an honorary membership in the American Institute of Electrical Engineers.

DR. FRED H. ALBEE, professor of orthopedics at the Post-Graduate Hospital, New York, has been made a Commander of the Order of Merit of Hungary in recognition of his work in bone surgery. Dr. Albee received the medal at the hands of the Hungarian consul general.

PROFESSOR AMÉDÉE GRANGER, of the graduate school of medicine of Tulane University, has received the decoration of Chevalier of the Order of the Crown of Belgium. The knighthood was conferred in gratitude to Dr. Granger for permitting Belgium to equip its surgeons with a device which he invented to locate minute bullets imbedded in the body.

DR. J. C. MEAKINS, Toronto, has been elected president of the Royal Canadian College of Physicians and Surgeons, which obtained a parliamentary charter last session. As vice-presidents there have been elected Dr. F. N. Starr and Dr. Duncan Graham, both of Toronto.

THE new advisory board of the Chicago Public Health Institute consists of Drs. Joseph Capps, Charles Elliott, Walter Hamburger, Ludvig Hektoen, Ernest Trone, Joseph Miller and Arthur D. Black.

AMONG appointments by the trustees of the British Museum are Mr. John Ramsbottom, to be keeper of botany on the retirement of Dr. A. B. Rendle on January 19, and Mr. Gilbert John Arrow, to be deputy keeper in the department of entomology. Mr. Ramsbottom has been deputy keeper in the department of botany since 1927. He has been in charge of the mycetological section, and has especially studied fungi in relation to economic questions. Mr. Arrow is an authority on Coleoptera and has produced three volumes on the fauna of British India.

THE Association of Official Agricultural Chemists, at its annual meeting in Washington, elected Dr. E. M. Bailey, New Haven, president; Dr. H. B. Haskins, Amherst, vice-president, and Dr. W. W. Skinner, chief of the chemical and technological unit of the Bureau of Chemistry and Soils, Department of Agriculture, secretary and treasurer, Dr. Skinner by reelection.

GRANTS of £50 have been made from the Thomas Smythe Hughes Medical Research Fund for 1929–30 to H. Avery for research on the localization and treatment of cerebral tumors produced experimentally with Jensen's yeast cultures and with neoplastic grafts, and to Mary F. L. Keene and Evelyn E. Hewer for the continuation of research on the development of the human foetus.

PROFESSOR A. C. GRUBB, of the department of chemistry of the University of Saskatchewan, who, with his family, has been spending a year's sabbatical leave at Pasadena, California, has returned to Saskatoon.

C. W. BISHOP, associate curator of the Freer Gallery of Art, has left Washington to resume archeological research work in China.

DR. R. KIMURA, chief geologist of the Geological Survey of the South Manchuria Railway Company, and Dr. T. Ito, assistant professor in the Tokyo Imperial University, are visiting the United States.

DR. MURRAY P. HORWOOD, associate professor of bacteriology and public health at the Massachusetts Institute of Technology, has completed a health survey of Holyoke, Massachusetts, with relation to tuberculosis.

PROFESSOR NORBERT WIENER, of the Massachusetts Institute of Technology, is visiting professor of physics at Brown University.

THE AMERICAN PHILOSOPHICAL SOCIETY, in association with the National Broadcasting Company, broadcasted the address of Dr. Elihu Thomson on "Why the 200-inch Telescope?" on December 6.

DR. EDWIN BIDWELL WILSON, president of the Social Science Research Council and professor of vital statistics in the Harvard School of Public Health, is to be the orator at the one hundred fifty-eighth convocation of the University of Chicago on December 17.

DR. LOUIS NAVIAS, ceramist in charge of research of the General Electric Company, will deliver the fourth series of Priestley lectures at the Pennsylvania State College from December 16 to 20. The lectures will deal with the interrelation of physical chemistry and ceramics.

DR. DEAN D. LEWIS, professor of surgery in the Johns Hopkins School of Medicine, gave on November 7 the first of the Albert Berney lectures at Mount

Sinai Hospital, New York, a series which has been provided for by Mr. Berney's friends in appreciation of his interest in the hospital.

DR. LIBERTY HYDE BAILEY spoke at Smith College on November 22 on "The Palm Hunter."

LECTURES at the experimental station of the Pennsylvania State College include Dr. S. A. Waksman, New Jersey Agricultural Experiment Station, on December 19; Dr. Roy Chapman, University of Minnesota, on January 16; Dr. C. H. Eckles, University of Minnesota, on February 20; Dr. Earl H. Clapp, U. S. Forest Service, on March 20; Dr. E. B. Hart, University of Wisconsin, on April 16; Dr. W. W. Garner, U. S. Department of Agriculture, on May 15, and Dr. J. B. Davidson, Iowa State College, on a date not yet announced.

DR. GEORGE D. BEAL, assistant director of the Mellon Institute of Industrial Research, addressed the Lehigh Valley section of the American Chemical Society on November 14. He spoke on "Some Contributions which Science is Making to Industry." Dr. Lawrence W. Bass, executive assistant, spoke before the Northern West Virginia section of the American Chemical Society on November 22 on "The Economic Effects of Industrial Research."

DR. HARRY N. HOLMES, professor of chemistry at Oberlin College, will give the three Christmas week lectures for young people, on the James Mapes Dodge Lecture Foundation of the Franklin Institute, Philadelphia, on December 26, 27 and 28. The title of the series is "It is a Colloidal World after all."

DR. MAX BODENSTEIN, director of the Physical Chemistry Institute, University of Berlin, gave a series of three public lectures on the "Chemical Actions of Light" on December 9, 10 and 11, at the Carnegie Institute of Technology, Pittsburgh. Dr. Bodenstein went from the Johns Hopkins University where, as the James Speyer visiting professor of chemistry, he has been giving a series of lectures.

LLEWELYN B. ATKINSON delivered on November 6 his inaugural address as chairman of the council of the Royal Society of Arts on "Fifty Years of Electrical Science and Industry."

M. DE DONDER, professor at the University of Brussels, gave recently six lectures at l'Institut Henri Poincaré, Paris, on the Einsteinian theory of gravitation.

THE meeting of the Colorado Wyoming Academy of Science was held in Colorado Springs with an attendance of 138. Seventy papers on original research were presented at the meeting. The Colorado Social Science Association also voted to join with the academy as a separate section. The following officers for the coming year were elected: L. W. Durrell, *president;* J. D. Heilman, *vice-president;* J. Harlan Johnson, *secretary;* W. C. Binkley, *treasurer.* The executive committee for the coming year is as follows: P. T. Miller, P. A. Boucher, F. C. Jean and R. A. Niswanger.

GENETICISTS attending the Des Moines meeting of the American Association for the Advancement of Science have been invited to visit the campus and exhibitions at Iowa State College at Ames, on Sunday, December 29, prior to the regular meetings on Monday, December 30, when the joint genetics sections and the organization of Geneticists Interested in Agriculture hold their sessions at Ames. The college, departmental exhibits and the headquarters (Memorial Union Hall) will be open Sunday and guides will arrange for inspection trips. Arrangements have been made to accommodate any number of guests at a new, convenient dormitory on Sunday night. Rates are $1.50 per day and reservations should be mailed to E. W. Lindstrom, Department of Genetics, Iowa State College, Ames, Iowa. Meals and group luncheons or dinners are easily and conveniently arranged at the Memorial Union Hall. Frequent and inexpensive bus service to and from Des Moines (34 miles south) will be available. Bus arrangements may be made at the headquarters hotel in Des Moines and at the Memorial Union Hall in Ames. Special buses may be had for any groups wishing to leave at specific times, especially for returning to Des Moines on Monday after the meetings.

THE American Astronomical Society will meet from December 30 to January 2, under the presidency of Dr. Raymond S. Dugan, at the Harvard College Observatory. One of the sessions will be held at the Whitin Observatory of Wellesley College. Aside from the usual features of the meetings, an excursion is planned for January 2 to West Lynn to visit the General Electric plant there and in particular to see the work on fused quartz mirrors.

THE annual general meeting of the American Philosophical Society will be held at Philadelphia on April 24, 25 and 26, 1930, beginning at 2 P. M., on Thursday, April 24.

THE next annual meeting of the Federation of American Societies for Experimental Biology will be held in Chicago from March 26 to 29, 1930.

THE fifty-ninth annual meeting of the American Public Health Association will be held in Fort Worth, Texas, during the week of October 27, 1930, with the Hotel Texas as headquarters.

THE Harriman memorial gold medal for 1928, awarded for the best safety record by a railroad operating 10,000,000 or more locomotive miles a year, was formally presented to the Union Pacific Railway by the American Museum of Safety at a luncheon on December 5 in the Metropolitan Club, New York City.

THE corporations of the New York Post-Graduate Medical School and Hospital and of the Reconstruction Hospital, at separate meetings on December 4, ratified the consolidation of the two institutions. The announcements were made by Dr. Edward Hume, executive vice-president of Post-Graduate, and by Allen Wardwell, president of the Reconstruction Hospital. After the merger is approved by the State Board of Charities and by the courts, the new institution will be known as the New York Post-Graduate Medical School and Hospital. Unified operation is expected to be effected about January 1. The Post-Graduate Hospital was founded a little more than forty-seven years ago. Its buildings are at 303 East Twentieth Street, at Second Avenue. The Reconstruction Hospital, which came into being during the Spanish-American War, is at 395 Central Park West. The combined capacity of the two institutions will be 500 beds.

THE establishment of a national land-grant college and university institute in Washington, D. C., to enable the land-grant institutions to contribute more effectively toward the solution of national problems, was urged by Anson Marston, dean of engineering of Iowa State College, in an address at the annual dinner of the Association of Land-Grant Colleges and Universities in Chicago, the evening of November 12.

THE New York State Psychiatric Institute and Hospital was dedicated on December 3 at the medical center of Columbia University. Addresses of welcome were delivered at the morning session, at which Dr. Nicholas Murray Butler and Acting Governor Herbert H. Lehman spoke. The afternoon meeting was devoted to the reading of scientific papers. Dr. Butler welcomed the institute to the medical center and declared that the new unit represents the cooperation of public and private services that is characteristic of American life.

THE Elizabeth Thompson Science Fund makes grants of small amounts of money for scientific research. The secretary will be glad to receive applications from men and women working in specialized fields of science, whether or not in academic institutions, who are unable to obtain funds elsewhere to initiate or complete investigations. Applications should be addressed to the secretary of the fund, Professor E. B. Wilson, 55 Van Dyke Street, Boston, Massachusetts.

THE future of the Radcliffe Infirmary and the Radcliffe Observatory, Oxford, are involved in a provisional agreement which has been concluded between Sir William Morris and the Radcliffe trustees. The trustees undertake to sell the observatory site to Sir William Morris for the sum of £100,000 and will lease the observatory buildings from him for a period of five years, after which the observatory will be removed to South Africa. Meanwhile the needed extensions to the Radcliffe Infirmary will be begun on the observatory grounds in the course of the next few months. The Radcliffe Observatory is said to be the second oldest observatory in the British Isles.

Industrial and Engineering Chemistry reports that the British Color Council was established October 9 as the result of a meeting supported by leading representatives of the textile trades, the dyeing industries and other interested industries, such as leather and shoe manufacturing firms. The proper classification of colors and the establishment of names to avoid a great variety for the same color was suggested as a reform to be brought about by the council. An international color conference was also suggested, as a preliminary to the adoption of an international color card, to facilitate the standardization of colors. At present entirely independent color cards are published in England, France, Germany, Switzerland and the United States. Another suggestion was the appointment of a technical adviser on the council, to advise members processing different types of fiber how the particular colors agreed upon could be supplied.

UNIVERSITY AND EDUCATIONAL NOTES

AT the dedication of the John Markle Mining Engineering Hall of Lafayette College on December 6, which was built at a cost of $500,000, given by Mr. John Markle, it was announced that $400,000 more had been given by Mr. Markle for endowment.

A GIFT of $1,000,000 from the family of the late Charles Dering, of Evanston, Illinois, has been made to Northwestern University for the construction of a new general library building.

DR. J. ERNEST CARMAN, professor of geology at the Ohio State University since 1917, has been made chairman of the department of geology. Dr. E. Willard Berry, who studied at the Johns Hopkins University and who has been with the International Petroleum Company in Peru for several years, has been appointed instructor.

CARL D. BRANDT, general superintendent and as-

sistant agent of the Bondsville Bleachery Company of Bondsville, Massachusetts, has accepted the position of head of the department of textile engineering in the Texas Technological College.

DR. JOHANNES NÖRR, professor of pathology and physiology at the University at Giessen, has been called to Munich.

FATHER FREDERICK W. SOHON has succeeded the late Father Francis A. Tondorf as director of the seismic station of Georgetown University.

DISCUSSION

RECENT DISCUSSIONS OF THE REDUCTION DIVISION IN DROSOPHILA MELANOGASTER

IN his well-known monograph on "The Genetics of Drosophila," published in Bibliographia Genetica, Vol. II, 1925, Morgan makes a statement that little or nothing is known of the reduction divisions in *Drosophila melanogaster*. Later in the same year, in collaboration with Professor G. C. Hicks, of the University of Buffalo, the present author described the meiotic or maturation phenomena in *D. melanogaster*. It was there pointed out that the absence of any adequate description of the maturation phenomena in *D. melanogaster* was deplorable in view of the heavy weight of biological theory that has been put upon its chromosomes. The results of Professor Hicks and the present author made it clear that the reduction divisions in this species are entirely abnormal and present a marked and apparently significant resemblance to the reduction divisions present in known hybrids. This general situation was correlated by us with the great variability of *D. melanogaster*, and it was emphasized that, both on account of variability and its unusual meiotic phenomena, *D. melanogaster* was to be regarded as a natural hybrid.

A significant silence has prevailed on this subject of Drosophila, until recently. In an excellent and beautifully illustrated volume[1] Belar has put forth the claim that the reduction divisions in *D. melanogaster* are normal, and is of the opinion that certain photomicrographs which he presents prove the correctness of this statement. In his Plate II, an actual photographic reproduction of his photomicrographs, in figures 5a, 5b and 5c, he shows the first division (reduction division) of the spermatocyte from the same nucleus in three different focal planes. In all these three figures, representing different foci, at least one chromosome of those appearing is far removed from the equatorial line. This situation corresponds exactly with the description furnished by Hicks and Jeffrey. It is obvious from Belar's own illustrations that there is no normal equatorial plate in the reduction division of *D. melanogaster*. Belar criticizes the use of Carnoy's fluid for preservation of the material. This criticism appears captious inasmuch as the author himself describes his own use of the same preservative in such difficult cases as fixing divisions in Nematodes. Further, Morgan himself has made use of Carnoy's solution in his important studies of the chromosomes in Aphids. It may be further added that Carnoy's solution is universally recognized by cytologists as a reliable reagent for the fixation of chromosomes. Belar's conclusions are all the more remarkable because he considers some of the structures seen in the nucleus and protoplasm in *D. melanogaster* to be abnormal vestiges of mitichondria produced by the reagents. This is all the more surprising because he claims to have obtained well-preserved mitichondria in his own preparations by the use of Flemming's fluid. It is surely universally known that Flemming's fluid will not preserve mitichondria. It accordingly is difficult to attach any great importance to Belar's criticisms, which seem to rest more on prejudice than a critical examination of the facts.

In the interval since the first paper on *D. melanogaster* we have examined a large amount of material of this species from various sources and from the wild, and have used chrom-osmioacetic mixture as well as Carnoy's preservative. The only difference that we have found between the former and the latter is that Carnoy's solution gave very much better preparations, showing a better fixation of all the tissues than did Flemming's solution. The situation in regard to the reduction division appeared in the addition material substantially the same as in our original description, and we accordingly stand by the results there obtained. It may be added that a very wide use of preservatives in connection with a range of studies covering both plants and animals has quite confirmed in our mind the approval of Carnoy's solution as a nuclear fixative which is in general voiced by cytologists.

Less excusable than Belar's criticisms are those made privately by certain American geneticists who affect to believe that the reduction divisions in *D. melanogaster* are perfectly normal and have always been known to be so. The most charitable view that one can take of such statements is that the authors are unfamiliar with Morgan's monograph on the

[1] "Die cytologischen Grundlagen der Vererbung," Berlin, Gebrüder Borntraeger, 1928.

species. It is true that the somatic divisions of *D. melanogaster* are quite normal, but that in general is true of all somatic divisions of all hybrids, as has been recently emphasized by the present author. This confusion of thought is probably the cause of a highly critical paper published recently in this journal by Huskins.[2] He expresses the view that a contrast in regularity between the somatic and reduction division is of no importance from the standpoint of diagnosis of hybrids. This opinion seems to have remarkably little justification. We are now acquainted with the remarkable meiotic or reduction phenomena in many hybrids, both plants and animals, and an outstanding feature of the maturation metaphase is, in the great majority of cases, the lagging of chromosomes, polypolidy, sterility and extreme variability. It is true there are certain hybrids which are fixed invariables from the first, and it is also true that there are forms of heterozygotes which present little or no sterility. This does not alter the fact, however, that sterility, variability and abnormal cytological phenomena are outstanding features of the reduction divisions in known hybrids.

We are now well acquainted with many large orders occurring in all parts of the world and including practically all groups of the higher plants in which all the criteria of hybridism are presented. Excellent examples of these are the genera Rosa, Rubus, Crataegus (in the northern hemisphere), and Eucalyptus, Acacia and Veronica (in Australasia), which manifest extreme variability, intergradation of species, polypolidy and the cytological phenomena of known hybrids.

It will probably become more and more apparent as a result of the increasing correlation of cytological and experimental work in biology that specific change more than anything else is the result of the crossing of species, in other words, of hybridization. Purely experimental work divorced from morphology seems to have as little future as the proverbial faith without works. The dangers of this way are well illustrated by the deplorable case of Paul Kammerer, whose experiments purporting to prove the production by experimental means of heritable characteristics were demonstrated by unprejudiced investigators to be based on fraud or extreme credulity or both.

EDWARD C. JEFFREY

HARVARD UNIVERSITY

THE DECOMPOSITION OF OZONE IN THE PRESENCE OF NITROGEN PENTOXIDE

THE rate of the catalytic decomposition of ozone in the presence of nitrogen pentoxide has been shown by Schumacher and Sprenger[1] to follow the expression

$$-\frac{d[O_3]}{dt} = k_1[N_2O_5] + k[N_2O_5]^{2/3}\,[O_3]^{2/3}$$

where the first term on the right-hand side of the equation gives the rate at which ozone is used in reoxidizing the nitrogen dioxide formed from the decomposition of nitrogen pentoxide, k_1 being the specific reaction rate constant for the first order decomposition of nitrogen pentoxide. When an appreciable amount of ozone is present the first term is small compared with the second and the expression can be written in the simplified form

$$-\frac{d[O_3]}{dt} = k[N_2O_5]^{2/3}\,[O_3]^{2/3}.$$

Similar results on the rate of this decomposition will be found in a thesis which I presented to the California Institute of Technology in May, 1928. Experiments were carried out at 25° C. and 35° C. The partial pressure of the nitrogen pentoxide was varied in the ratio 1:30. The maximum partial pressure of ozone was forty millimeters mercury. Two pyrex reaction vessels were used, one of 20 cc volume and the other 300 cc volume. The pressure was followed by means of a click gauge, so the gases were in contact with only glass during the decomposition. Most of the experiments were carried out with a large excess of oxygen, the total pressure approximating one atmosphere, but in three experiments the pressure was reduced to one half atmosphere and in one experiment to one quarter atmosphere. All partial pressures were determined from direct pressure measurements, the start of the nitrogen pentoxide decomposition being marked by a "kink" in the pressure increase time curve, and also by the appearance of a brown color. Tank oxygen was used in all experiments.

In my work the order of the reaction was found to be two thirds with respect to the nitrogen pentoxide pressure, and slightly lower than first with respect to the ozone pressure. The ozone pressure was not varied over a sufficiently wide range to determine exactly the order with respect to the ozone.

The data have been fitted to the simplified expression given by Schumacher and Sprenger and constants calculated. These constants were compared with those calculated to 25° C. and 35° C. from the work of the above experimenters. An agreement within 10 per cent. was obtained.

The work was carried out at the suggestion of Professor R. C. Tolman, and the present note is

[2] SCIENCE, n. s., Vol. 69, No. 1789.

[1] Schumacher and Sprenger, *Zeit. für physikalische Chem.*, 140: 267, 1929.

published as a confirmation of the results presented by Schumacher and Sprenger.

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MECHANICS OF FLUIDS IN RECENT TEXT-BOOKS OF PHYSICS

EVERY few years it becomes necessary for a teacher of physics to choose a new text-book from the large variety offered by the publishers, or at least to look over the list to see if there is a new one which is more suitable than the one he has been using. If he has plenty of time, he may look carefully through many books; if not, he may, as I have done, choose one subject in the books and compare the authors' treatment of that. It has been my habit to study the chapters having to do with the mechanics of fluids, particularly liquids. Why is it that less care seems to be exercised in writing this part of a physics text than any other?

A quite recent and excellent text has this statement in italics: *"The force which a liquid exerts against any surface is equal to the area of the surface times its average depth times the density of the liquid,"* and later makes use of the formulas: $F = Ahd$ and $p = hd$. As the authors of this text define density in the usual way as the mass per unit volume of a substance, pressure can not be equal to height times density. The dimensions will not agree. The pressure at a given point in a liquid depends not only on the depth and the density but also on the pull which the earth exerts on each unit mass of the liquid, that is, on the value of the acceleration of gravity. $P = hdg$. We may write $P = hd$ if we choose to define density as the weight per unit volume as is sometimes done, but in that case we may not write the formula for the velocity of a compressional wave in an elastic medium in the form $V = \sqrt{\frac{E}{d}}$.

Very few text-books make a complete statement of the principle of buoyancy or Archimedes' principle. The usual statement is that a body wholly or partly immersed in a fluid is buoyed up by a vertical force equal to the weight of the fluid displaced. Is it not important to state that we may consider the center of gravity of the fluid which the body displaces as the point of application of the buoyant force? I find that the average student assumes, often incorrectly, that the buoyant force acts at the center of gravity of the immersed body.

The subject of "The Siphon in Text-books" has been very well discussed by Professor Harold C. Barker in SCIENCE.[1] I can add nothing to that except to call attention to the fact that some of the most recent texts discuss the siphon under the subject "Fluids at Rest" and that a very careful reading of some of them will fail to show even why a siphon starts to operate. No effort is made to show why it continues to operate, or to show that stable operation can take place only when the highest part of the tube is less than barometric height above the *intake and outlet*. If we discuss this with the author, perhaps he will say he considers the subject of fluids in motion and Bernoulli's theorem too difficult for beginning students. Perhaps it is, but it would be better to tell what a siphon does and state its limits of operation without explanation than to give an explanation which pretends to tell the story and does not do so.

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[1] 51: 489–491, May 14, 1920.

PETRIFIED WOOD IN THE NEW ALBANY SHALE

THERE have been frequent references to petrified wood in the black shales of Indiana, Kentucky and Ohio. Silicified tree trunks were reported from the vicinity of Lebanon, Kentucky, at the New Haven meeting of the American Association for the Advancement of Science in 1850. Reports of the state geological survey occasionally mention such wood in Indiana, and in 1914 Elkins and Wieland described an Indiana specimen as *Callixylom Oweni*. Petrified wood has also been found in the concretions of the black shale of Ohio, and several years ago Dawson described one Ohio specimen as *Dadoxylon Newberryi*. Aside from this, very little systematic study of this wood has been made.

Field investigations during the past summer showed that petrified wood is quite common, though widely scattered, throughout parts of these states. It is especially abundant in the New Albany shale of Scott County, Indiana, and probably occurs at numerous other places throughout the state where this shale is exposed.

The thickness of the New Albany shale and the readiness with which it weathers produce a rolling topography which is devoid of striking geologic formations or extensive rock exposures. Consequently the contained silicified wood is rarely found *in situ* but as loose material in stream beds and on gently sloping weathered hillsides. The shale is quarried extensively in southern Indiana for road construction, but in most instances the petrified logs are removed from the quarry as impediments as soon as they are discovered.

One exception, however, is worthy of note. In a quarry in the vicinity of Scottsburg a stump with the lower portion of the trunk attached was found still partly buried in the shale. The specimen was three feet broad near the base, tapered to two feet at the

opposite end and was over five feet long. The stump appeared to be bulbous but showed nothing of the attachment of the roots. Being completely decorticated it showed no surface characters. Several other large pieces of wood were scattered over the floor of the quarry, and according to the owner the largest specimen, measuring about three by eight feet, had been blasted to pieces and used in the construction of a bridge foundation.

Preliminary investigations show that the wood from the New Albany shale is Callixylon. This genus is also known from south Russia, the Hunton formation of Oklahoma, the Chattanooga shale of Kentucky, the black shale of Ohio and in great abundance throughout the lower half of the upper Devonian formations of central and western New York. It has also been found in the glacial drift of Michigan. In New York only fragments of small branches, twigs and roots are known, while in Indiana only large trunks have been seen so far. Specific determinations of the Indiana material have not been made.

Although the wood is widely scattered, it appears to occur mostly near the top of the New Albany formation. While formerly considered as belonging to the upper Devonian and of the same age as the Genesee shale of New York, the New Albany shale is now viewed by some competent authorities as being, at least in part, of lower Mississippian age. This would place the Indiana wood in the Mississippian, and thus extend the range of Callixylon from the Devonian up into the Carboniferous. However, there is no record of its occurrence any higher than this basal member.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN AUTOMATIC MICROSPIROMETER

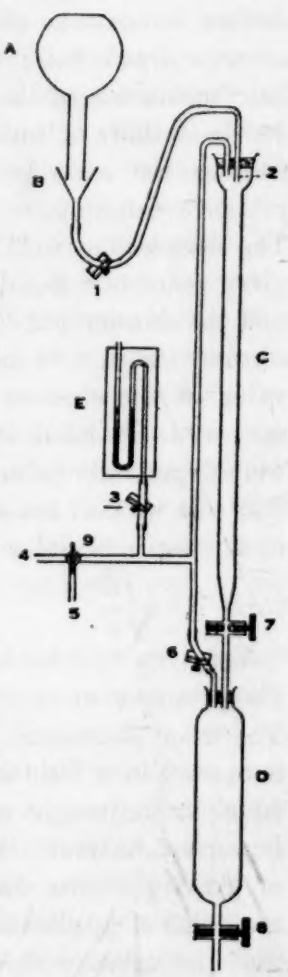
IN metabolic studies on the incubating hen's egg the writer has carried out continuous determinations of oxygen absorption and carbon dioxide production. At the beginning of incubation the egg is placed in a specially constructed metabolism apparatus in which it remains excluded from the outside air until hatched. The rate and total oxygen consumption and carbon dioxide elimination may be calculated at any time during the development of the embryo. A complete report will be published at a later date.

The oxygen spirometer developed to meet the requirements of the experiments has proved adaptable to a wide range of respiratory experiments. It is employed with satisfactory results by Dr. J. O. Ralls, of the biochemistry department of the University of Buffalo, in metabolic studies on rats.

The spirometer used in my experiments is illustrated in the accompanying figure. It is simple in construction, being made up of ordinary standard laboratory equipment. The neck of a 1,000 cc volumetric flask *A* rests snugly in funnel *B*. *C* is a 50 cc burette and *D* a 500 cc separatory funnel. *E* is an ordinary manometer constructed of 4 mm glass tubing and filled with red kerosene. These parts are connected as shown in the illustration.

In principle the apparatus depends upon the replacement of consumed oxygen by fluid without abnormal variations in pressure. In order to control humidity I have employed a saturated solution of sodium chloride.

The procedure for a continuous experiment is as follows: The manometer *E* being empty the volumetric flask *A* is filled with the sodium chloride solution and inverted in funnel *B*. By manipulation of cocks *7* and *6*, the solution is allowed to displace the air from the apparatus through the manometer. The solution is allowed to pass up in the manometer tubing until it reaches manometer fluid level at *e*. By closing pinch cock *1*, the fluid is drawn from the manometer through stop cock *8*, then by closing pinch cock *3*, the fluid is displaced through *8* by oxygen coming in at *5*, taking care to leave enough fluid to fill the lower end of burette *C* to the 50 cc mark.



By measuring the displaced sodium chloride solution the volume of the spirometer above and below cocks *6* and *7* is determined. The sum gives the total volume of the spirometer. The two volumes are determined separately so that the burette part may be used independent of the separatory funnel especially during the first eight days of incubation when the chick will not use over 50 cc of oxygen in twenty-four hours. The air volume of the egg chamber having been previously determined, the total volume of the apparatus is known. These data are necessary for barometric and temperature corrections. An ideal place of operation is a constant temperature room.

After releasing cock *3*, kerosene is placed in the manometer to level *e*. Then *B* is adjusted level with *2* which is a glass tube drawn to a suitable capillary point. Cock *6* is closed, *7* being already closed with fluid in the burette to the 50 cc mark. Cock *1* is released and the spirometer connected to the egg chamber by the three-way cock *9*. By opening cock *8* the manometer is adjusted to zero, at which time barometric and temperature readings are taken.

The CO_2 is absorbed in the egg chamber and as oxygen is consumed a negative pressure results, as will be indicated by the manometer. But if *B* is properly adjusted on a level with *2* the oxygen used will be immediately replaced with fluid from the volumetric flask flowing into the burette. Thus the oxygen consumption may be read at any time by the fluid level in the burette.

The readings are made at some selected age hour interval. About thirty seconds before the hour the manometer is adjusted to zero by either letting in or drawing out fluid as the case needs be. The zero reading is maintained as the hour strikes, at which time the fluid level in the burette is noted, then immediately the barometric and temperature readings are taken. With the data in hand the oxygen consumed may be reduced to standard readings.

The separatory funnel serves as a reservoir. When the burette is filled near its limits, cocks *6* and *7* are opened and the surplus fluid drained in to *D*, the oxygen being automatically displaced from *D* into *C*. When *D* is filled the fluid is displaced with oxygen from the supply tank as at the beginning of the experiment. The fluid is measured and replaced in the volumetric flask, the same fluid being used repeatedly.

During the first five days of incubation the 50 cc burette will take care of the entire oxygen consumption. In the last half of incubation the rate of oxygen consumption of the egg rapidly approaches 40 to 50 cc per hour, which it reaches just before hatching. When the oxygen consumption is likely to be more than the measuring capacity of the burette during the absence of the observer, the cocks *6* and *7* are left open, allowing the fluid to flow into *D*. On the observer's return the fluid may be displaced with oxygen and measured. Care must always be taken to first adjust the manometer reading to zero and to note barometric and temperature readings at the same time any fluid measurement is made. The egg chamber is of sufficient size to permit the spirometer to be shut off for a short period without disturbing the physiological control.

The advantage of this spirometer is that it permits fairly accurate measurements of rapidly varying rates of oxygen consumption. The measurements may be made over an entire biological period. This is very advantageous in studies of ontogenetic energy. I feel that the principle may be used for studies of oxygen consumption in tissue cultures, insects and small mammals or vertebrates.

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SPECIAL ARTICLES

COW'S MILK AS A SOURCE OF VITAMIN B FOR LACTATION

IN 1924 I produced experimental evidence[1] that a ration containing 50 per cent. skimmed milk powder as the only source of vitamin B was inadequate for rearing of young when lactating rats were allowed litters of six young to nurse. When such diets, however, were fortified with a brewer's yeast concentrate entire failure was changed to complete success in lactation.[2] The conclusion was then made that the vitamin B requirements for lactation are much greater than those for growth, and that cow's milk is deficient in vitamin B for milk secretion. Since no method is available for collecting the milk secreted by a rat, the criterion for successful lactation used by all nutritional investigators is the character of growth of the nursing young when a specific dietary essential is the only limiting factor in a ration. In 1927, using diets (provided with a satisfactory salt mixture containing an abundance of ferric citrate) composed of purified food substances, I demonstrated that the vitamin B requirements for lactation are at least three times those necessary for normal growth.[3] Recently I have developed quantitative biological methods for studies of lactation and vitamin requirements of nursing young of the albino rat[4] which have disclosed the fact that the great requirements of vitamin B for lactation are due to the lactating mother's dissipating over 60 per cent. of the vitamin in the metabolism of transfer to the milk. My methods involve transfer experiments from stock diets to purified synthetic

[1] B. Sure, *J. Biol. Chem.*, 1924, 62: 371–396.

[2] Since these milk diets were fortified with ferric citrate, iron was ruled out as a limiting factor in failure of lactation. That copper, another mineral element deficient in milk, is not a complicating factor in the vitamin B lactation problem has also been recently demonstrated. See *J. Biol. Chem.*, 1928, 80: 289–295.

[3] *J. Biol. Chem.*, 1927, 74: 55–69.

[4] *Ibid.*, 1928, 76: 685–700.

diets complete in every respect with the exception of the vitamin to be investigated. The lactating mother must first be entirely depleted of all storage from the previous dietary régime before any vitamin-containing material may be subjected to biological assay. Unless depletion is first secured, all such transfer experiments yield nothing but irregular and in many instances absolutely erroneous results.

My results on the great requirements of vitamin B for lactation have been substantiated by the work of Macy and coworkers[5] and by Evans and Burr.[6] Daniels, Jordan and Hutton[7] have, however, recently introduced confusion in the literature and it is the purpose of this communication to point out to the latter investigators the reasons for their conflicting evidence. In the first place, Daniels and coworkers after making their transfer experiments from stock diets have failed to deplete the lactating mothers from vitamin reserves. The second point of weakness lies in their dietary management. Instead of proceeding with a diet complete in every respect with the exception of the vitamin B factor, they attempt to feed liquid or dry milk as the sole source of a maternal ration for lactation. In this connection it may be pointed out that Daniels and coworkers[8] have recently made definite conclusions, employing the lactation method of biological assay, on the destruction of vitamin B in evaporated milk, in which study they used a ration consisting of casein, bread, cod-liver oil, ferric citrate and potassium iodide —another diet deficient in more than one factor, *i.e.*, minerals. Such technique could not possibly lead to results worthy of conclusions of any consequence. The third error these investigators have made is the departure from the standard technique of using four instead of six young in the litter. Since seven to eight young is the average size of a litter of the albino rat, six young would certainly be a more accurate and severer test than four young. The conclusion of Daniels *et al.* that "it would seem that any food which can furnish enough of the antineuritic vitamin for the development of four suckling rats must contain enough for the normal human infant" has no basis for consideration. Although the young rat grows about twenty-five times as fast as the baby, the baby weighs about 650 times as much as the rat at birth, and approximately 300 times as much as the rat at weaning. Besides, final deductions with regard to the rôle of vitamin B in infant nutrition, especially dosage, must come from the clinicians.[9]

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THE NATIONAL ACADEMY OF SCIENCES. II

The preparation of an active extract of the suprarenal cortex: W. W. SWINGLE and J. J. PFIFFNER (introduced by E. G. Conklin).

Studies on an active extract of the corpus luteum: J. J. PFIFFNER (introduced by E. G. Conklin).

On the use of oblate ellipsoids for the measurement of magnetic susceptibility in anisotropic substances: DONALD FOSTER (introduced by C. J. Davisson). If the results of magnetic measurements are to be independent of the exterior form of the specimen, it is necessary to produce uniform magnetization and to determine the intensity of the effective magnetic field inside the material. These two requirements introduce fundamental and persistent difficulties in all magnetic measurements. Uniformity of magnetization of a body placed in a uniform field requires that the surface of the body be of the second degree. The field intensity is then calculable for certain directions of magnetization. On this account, the ellipsoidal form of specimen is unique; and it has been commonly used, especially for measurements on single crystals. When oblate ellipsoids are used the susceptibility may be measured in various directions while employing only one specimen. It is shown in this paper that the results of such measurements are ambiguous because they depend on the orientation of the minor axis of the ellipsoid with respect to the crystallographic axes. As an example, it is shown from published data on iron crystals that the I, H curves for a given crystallographic direction in different ellipsoids may differ as much as do the curves for different directions. The difficulty may be avoided by using crystals in the form of straight wires.

On the polarization of X-radiation: WILLIAM DUANE. Previous papers have described experiments with X-rays produced when electrons impinge against free atoms in a gas. This paper describes experiments on the polarization of the X-rays. The details of the researches may be found in the November, 1929, number of the *Proceedings* of the National Academy. The results indicate that, even when all the electrons have practically the same speed

[5] I. C. Macy, J. Outhouse, A. Graham and M. L. Long, *J. Biol. Chem.*, 1927, 73: 189–201.
[6] H. M. Evans and G. O. Burr, *ibid.*, 1928, 76: 263–273.
[7] A. L. Daniels, D. Jordan and M. K. Hutton, *J. Nutr.*, 1929, 2: 19–29.
[8] A. L. Daniels, M. L. Giddings and D. Jordan, *J. Nutr.*, 1928, 1: 455–466.
[9] R. J. Hoobler, *J. Am. Med. Ass'n.*, 1928, 91: 307–310; R. H. Dennett, *ibid.*, 1929, 92: 769–772; J. I. Waring, *Am. J. Dis. Child.*, 1929, 38: 52–57; A. P. Bloxsom, *Am. J. Dis. Child.*, 1929, 37: 1161–1169; S. V. Haas, *Arch. Ped.*, 1929, 46: 467–479; G. W. Bray, Roy. Soc. Trop. Med., *Hyg. Trans.*, 1928, 22: No. 1, 9–42.

and direction of motion, the X-rays are not completely polarized. The degree of polarization amounts to about 0.50. Other details of the results will be discussed as thoroughly as time permits.

The distribution of light intensity in a Fresnel diffraction pattern: THEODORE LYMAN. Fresnel in his celebrated memoir calculated the distribution of the intensity of the light in the diffraction pattern from a straight edge for the case where source and screen are separated by a finite distance. He then verified the results of his calculation by experiment with such a satisfactory degree of accuracy that no one since his time has been tempted to repeat his work. His quantitative results, however, were concerned only with the positions of the maxima and minima in the pattern; he did not possess the means of measuring the relative intensity of the light. As far as I am aware, all those who have studied diffraction patterns since the time of Fresnel have also confined their experimental investigations to determinations of the positions of maxima and minima (see for example, Hufford and Davis, *Phys. Rev.*, 33: 589, 1929). In view of the interest that is taken nowadays in the theory of diffraction phenomena of this type is seemed worth while to make an attempt to measure the relative intensity of the light in various parts of the pattern from a straight edge. In this attempt I have employed photographic photometry. The results agree with the predictions of Fresnel's theory to a degree of accuracy limited by the experimental error. The paper gives some details of the procedure.

On mosaic crystals: F. ZWICKY (introduced by R. A. Millikan). Properties of solids may be roughly divided into two groups. Properties of the first group are "structure insensitive." They can be accounted for by the theory of ideal crystal lattices. This theory, however, is utterly helpless in regard to properties of the second type, which are "structure sensitive." The conception of a mosaic structure of the crystals provides a solution of the difficulties involved. It can be shown by a very general consideration that an ideal crystal, though dynamically stable, is thermodynamically unstable. A really stable atomic lattice is characterized by the fact that on top of the primary structure as deduced from the X-ray structure analysis there is superposed a secondary structure, which shows perfect regularity also. In general, it has to be interpreted as a slight periodic change in density. The elementary spacing of the secondary structure (mosaic) is usually to be found in the region from 100 Å to 10000 Å. Structure insensitive properties depend mainly on the primary lattice, whereas structure sensitive properties are essentially related to the secondary lattice. A great number of phenomena can immediately be accounted for quantitatively. Several very interesting predictions of optical, mechanical and chemical effects, which so far were unknown, could already be verified in the laboratories of the institute.

The experimental evidence of the mosaic structure of Bi single-crystals: ALEXANDER GOETZ (introduced by R. A. Millikan). The presented subject concerns observations obtained in two different ways on single-crystals of Bi, the interpretation of which leads to the assumption that these crystals consist of small blocks of a definite size, which size is independent of the perfection of the crystal or the method of its production. (a) The microscopic investigations of fresh cleavage planes (111), using the largest resolving powers, show the presence of a triangular pattern of lines (in undistorted regions), the distances involved being always a small whole-number-multiple of $1.4 \pm 0.2\,\mu$. The etching process applied to these planes shows that these lines [indicating the penetration of the $(11\bar{1})$ planes through the (111) plane] possess a larger chemical passivity than the region surrounded by them. Hence they predetermine the size and position of a smallest etching figure identical with the size of an element of the mosaic structure. The calculated size for Bi is ca. $1.8\,\mu^3$. The element contains ca. 5×10^{10} atoms. (b) Investigating the conditions under which it is possible to predetermine the orientation of a crystal by inoculation with a seed-crystal, indications were found of the existence of a "block-state" over a small range of temperature (1°–2°) near the melting-point. The orientation of the final crystal as well as its perfection depends on the influences applied to this state.

The possible influence of the Mosaic structure on the determination of Avogadro's number: F. ZWICKY (introduced by R. A. Millikan). The direct determination of X-ray wave-lengths, making use of ruled gratings (Bearden), gives values which are ca. 0.2 per cent. higher than those obtained by reflection from crystals (Siegbahn). The theory of the mosaic structure of crystals, recently proposed by the author, suggests a possibility of accounting for this discrepancy. The mosaic pattern of rocksalt, for instance, is represented by a cubic frame work of planes whose density is about 5 per cent. larger than the density of the perfect blocks in between them. As the latter ones cause the interference of the X-rays, their characteristic lattice constant d must be introduced in Bragg's formula. d is obviously larger than the d_o which is usually obtained by assuming that the crystal is of perfectly uniform density throughout. For rocksalt, the theoretical estimate is $3 \times 10^{-4} < \frac{d-d_o}{d} < 3 \times 10^{-3}$. Experiments are being carried out at this institute to test whether the above considerations can be substantiated.

The Boltzmann distribution law in quantum theory: EDWIN H. HALL. At the Solvay Conference of 1924, which dealt with the subject of electric conduction in metals, the question arose as to whether the Boltzmann distribution law in its simplest form holds between n, the number of "free" electrons, and n_o, the number of unionized atoms, per cu cm of the metal. Q being the amount of energy required to ionize an atom within the metal, the law in question can be stated, tentatively, thus: $n = n_o \varepsilon^{-(Q \div kT)}$, (A). It was in fact so stated by O. W. Richardson in the following inquiry (p. 128 of the Conference Report): "Does the formula [given above] hold in the theory of quanta?" A number of the confrères present confidently expressed the opinion

that it did hold. Others, including Lorentz and Bridgman, expressed a doubt. A reader of the whole report would be likely to get the impression that the conference approved the use of the equation, in the form given above, as governing the amount of ionization within a metal. One member said, "The Boltzmann equation applies even in cases where one can apply the rules of quanta. It is thus that Einstein made use of it in 1917 in his derivation of the law of Planck." The paper of Einstein here referred to is printed in the *Physikalische Zeitschrift*, 18: 121–128. The following passage occurs on p. 122: "According to the quantum theory a molecule of a given kind can, apart from its orientation and motion of translation, take only a discrete series of conditions $Z_1, Z_2 \ldots Z_n \ldots$, the internal energy of which shall be $E_1, E_2 \ldots E_n \ldots$. If molecules of this sort belong to a gas of temperature T, the relative frequency W_n of the condition Z_n is given by the formula $W_n = p_n \varepsilon^{-(E_n \div kT)}$, (5), corresponding to the canonical distribution of states in statistical mechanics. In this formula k $(= R \div N)$ is the familiar Boltzmann constant, p_n a number, independent of T, characteristic of the molecule and of its n^{th} quantum condition, which can be defined as the 'statistical weight' of this condition. The formula (5) can be derived from the Boltzmann principle or by a purely thermodynamic method. Equation (5) is the expression for the widest generalization of the Maxwellian distribution law of velocities." It is to be observed, however, that Einstein's equation (5), when applied to the two quantum conditions m and n, gives $W_m = \frac{p_m}{p_n} \cdot W_n \varepsilon^{-(E_m - E_n) \div kT}$, (B). There is nothing in Einstein's paper to show that $(p_m \div p_n)$ must be 1. If this factor must be used in applying the Boltzmann formula between two different quantized states, it must be necessary to use some corresponding factor in applying this formula between quantized and unquantized states. Accordingly, it would seem that Richardson's question should be answered in the negative, unless the formula which he gave is to be amended so as to read $n = \frac{p_n}{p_{n_0}} \cdot n_0 \cdot \varepsilon^{-(Q \div kT)}$, (C), where $(p_n \div p_{n_0})$ is a factor to be determined.

Geometrical optics in an absorbing medium: P. S. EPSTEIN (introduced by R. A. Millikan).

Ozone in luminescence: E. L. NICHOLS and FRANCES G. WICK. Various substances previously rendered thermoluminescent by the action of X-rays were exposed for several minutes at room temperature to a current of air a portion of the oxygen content of which had been converted into ozone. The following results were obtained. (1) The intensity of the luminescence subsequently developed by heating was in all cases markedly reduced. (2) During the exposure to ozone the oft-times very feeble glow exhibited by substances after being subjected to X-rays which occurs even at ordinary temperatures was enhanced. We conclude that excitation is a dual process consisting: (a) of reduction in which the oxygen set free is in an active state; (b) in the reoxidation of the reduced product. Also that reduction in which active oxygen is not formed may result in luminescence by subsequent exposure to ozone or presumably to other active forms of oxygen.

A theory of the increase in thermionic and photoelectric emission due to adsorbed electropositive atoms: J. A. BECKER (introduced by C. J. Davisson).

Foundations of relativistic cosmology: H. P. ROBERTSON (introduced by Oswald Veblen).

Secondary electron emission from a cathode in ionized neon: W. UYTERHOEVEN and M. C. HARRINGTON (introduced by K. T. Compton). An attempt is made to measure the secondary emission under positive ion bombardment of metal collectors in the positive column under conditions as near as possible to those in the cathode fall. A combination of a fixed collector and a movable one opposite the first was used. The movable one was given a negative potential and the ion current to it compensated; then the potential of the fixed electrode was varied and the corresponding change in current to each measured. The results obtained so far show that for an accelerating potential of about -150v, the secondary emission can reach 50 p.c. of the total current collected on a negatively charged electrode. (*Proc. Nat. Ac. Sc.*, 15: 32, 1929.) The electron mean free path seems to depend markedly on the degree of ionization of the gas, the measured values being less than the gas kinetic values (*e.g.*, 50 p.c.). A large fraction of the electron emission from the metal is apparently due to the impact of metastable atoms on the collector (Oliphant, *Proc. Roy. Soc.*, A124: 228, 1929), but for higher accelerating potentials of the positive ions their effect becomes more and more important (Penning, *Physica*, 8: 13, 1928).

The solution of problems in the designs of statically indeterminate structures through study by elastic models: GEORGE E. BEGGS (introduced by L. B. Stillwell). A structure is statically indeterminate when the forces reacting against or within the structure can not be determined by the three equations of equilibrium. Some of the important types of indeterminate structures are continuous girders and trusses, arches and arch dams, tunnel sections, continuous frames and suspension bridges. For the design of such structures, elaborate mathematical methods have been developed, but these methods are often inadequate and impractical for the solution of many problems. With a view to eliminating the tedious and disheartening calculations which have limited the freedom of engineers in creating economical and beautiful forms of construction of the indeterminate type, the writer has developed methods for design through experiment with elastic models. By proper procedure it is possible by such methods to predict not only the nature of structural action, but also to evaluate the stresses and strains in the full-sized construction represented by the model and to estimate the safety of the construction.

Meusnier families of curves: E. KASNER.

Tertiary and Quarternary history of Yellowstone Park: R. M. FIELD (introduced by W. B. Scott).

Maps of the Pleistocene glaciation: C. A. REEDS and E. ANTEVS (introduced by J. C. Merriam).

Suggested correlation of solar radiation weather and varved clay: CHESTER A. REEDS.—The varved glacial clays which record the annual retreat of the last Continental ice sheet from North America, Sweden, Finland, Argentina, and elsewhere, exhibit three noticeable variations in sedimentation. First, a seasonal variation which postulates a strict periodicity not only in the melting of the ice, but in the deposition of the summer and winter layers; second, an annual variation in which regular changes in thickness occur from year to year, and third, in groups of years. The varves vary in thickness for different deposition basins, but as the relative differences remain constant over wide regions it is possible to identify and correlate the varves in separate sections. It has been shown that weather and solar radiation changes occur in groups of years simulating those of the varved clays.

In order to investigate the possible relation between varved clays, weather and solar radiation, the varved clays at Haverstraw, New York, and New Haven, Connecticut, have been measured, correlated and diagramed. The Haverstraw clays have been measured by Chester A. Reeds and Ernst Antevs working independently. Antevs has sectioned the New Haven clays and correlated them with the Haverstraw deposits. The clays at Haverstraw reveal a record of 736 consecutive years in their deposition, while those at New Haven cover a period of 343 years. Where the graphs of the separate deposits overlap they show close agreement. In addition to the annual variation these graphs indicate a thickness of sediments in groups of three, four and five years with occasionally larger and smaller groups. The means of each four consecutive varves suggest the correlation with the weather and solar radiation changes, as noted by Mr. H. H. Clayton (1923). Mr. Clayton has observed that the solar radiation measurements of the Astrophysical Observatory of the Smithsonian Institution clearly indicate the existence of a three to four year change in solar radiation, which is reflected in a three to four year change in pressure, rainfall, etc. These changes he attributes to a variability in the intensity and amount of faculae on the surface of the sun. It has been shown by Dr. C. G. Abbot that there is a real relation, though not a very close one, between sun-spots and solar radiation. Investigators agree that weather conditions are far more variable than sun-spot numbers. The means of four, eight and eleven varves show that the short fluctuations of four years were more prominent than the longer ones. Since the curves from the different areas simulate one another, it may be assumed that the yearly variation in thickness and in groups of years was not due to local conditions, but to primary factors embracing a variable fluctuation in the melting of the ice from year to year and in periods of years. These in turn were governed by fluctuations in the weather and solar radiation extending over seven and one third centuries.

The hoofed animals of the Patagonian Miocene: W. B. SCOTT. The Tertiary formations of Patagonia contain a series of ungulate groups which more or less parallel those of the northern hemisphere but are very distinct from them. Most of these groups are known with a fair degree of completeness, so far as their osteology is concerned; but two groups, the Astrapotheria and the Entelonychia, have been almost unknown save for the skull. The material collected by Mr. E. S. Riggs, of the Field Museum in Chicago, contains skeletons of both of these groups, and it is now possible to assign them to definite systematic positions. Thanks to the kindness of Mr. Riggs, who collected these specimens, I have been able to study them. The Entelonychia were a branch of the dominant South American group of the Toxodontia, in which the hoofs had been converted into blunt claws and the forefeet modified for digging. The whole extraordinary anatomy shows, as Lydekker was the first to suggest many years ago, that these were fossorial in habit. They were far too large to be burrowers, but no doubt sought food, such as roots and tubers, by digging it up. The Astrapotheria had a certain superficial resemblance to elephants. The skull indicated decidedly the presence of a long proboscis; the limbs are remarkably elongate and slender in proportion; the foot is five-toed and very elephantine in appearance, but not in detail. The practice oft followed of putting the Entelonychia and the Astrapotheria into the same order rests entirely upon insufficient information. The new material shows that it is quite untenable.

Two isomeric lactones of rhamnonic acid: C. S. HUDSON and E. L. JACKSON.

The quantum efficiency of ozone formation in the fluorite region: W. ALBERT NOYES, JR., and WILLIAM E. VAUGHAN (introduced by W. A. Noyes). The quantum efficiency of ozone formation in the fluorite region has been determined by two different methods. In the first of these the intensity of the incident radiation was measured and the amount of absorption by the oxygen in the discharge tube determined in a separate experiment. The oxygen was at atmospheric pressure and the ozone was determined by a colorimetric method using the starch iodide reaction. The rate of flow of the oxygen was varied over wide limits to test the validity of the assumption of negligible photo or thermal decomposition. In the second series of experiments the intensity of the radiation was measured back of the reaction vessel and the amount of absorption determined directly. The same method of analysis, using both acid and basic solutions of potassium iodide to absorb the ozone, was employed. The average of the first series of measurements gave 2.2 molecules of ozone per quantum absorbed by the oxygen, and the second series 1.9. The relationship of these values to the band spectrum of oxygen is discussed and they are found to agree with the most probable prediction of theory. A slightly higher value might not be impossible if the interpretation of the band spectrum is slightly modified.

The study of chain reactions: H. S. TAYLOR (introduced by G. A. Hulett).

Morbidity and the association of morbid conditions: E. B. WILSON.

Bird-life of Mt. Duida, Venezula: F. M. CHAPMAN.

On new measurements on the intensity of cosmic rays as a function of depth beneath the surface of the atmosphere: R. A. MILLIKAN and G. H. CAMERON. New measurements on cosmic rays made by the most sensitive electroscope which the authors have thus far used bring to light three results of significance. First, the existence of very considerable homogeneity in the penetrating power of the rays responsible for the bulk of the ionization in the upper atmosphere. Second, the existence of an exceedingly hard component in the cosmic rays in excellent agreement with the recent findings of Regener. Third, the fact, heretofore ignored in all theories, that the nucleus plays an important rôle in the absorption of cosmic rays.

High frequency electric discharges in "non-conducting" vacua: R. W. WOOD. Discharges in vacua, usually regarded as non-conducting, were excited by a "continuous wave" tube oscillator having a frequency corresponding to a wave-length of $1\frac{1}{4}$ meters, with a potential of only a few hundred volts. Very remarkable changes in the gas content of the sealed tube under excitation were observed, the same tube showing a spectrum of pure atomic hydrogen, or pure oxygen, at the will of the operator. Luminous masses of singly ionized molecules of very definite shape (spheres, pointed spindles and pear-shaped bodies) appear in the tube, and their movements under magnetic and electric forces have been studied. These bodies may distribute themselves periodically along the tube, giving an appearance which reminds one strongly of stationary waves.

Capture of electrons by alpha particles: A. H. BARNES and BERGEN DAVIS. Swiftly moving alpha particles are passed through a highly evacuated vessel. They are deflected by a magnetic field and fall on a zinc sulphide screen, where they produce scintillations. There were about 60 alpha particles per minute, each having a velocity of 1.45×10^9 cm/sec. It was so arranged that electrons emitted by a hot filament were made to follow after the alpha particles by a suitable electric field. The alpha particle thus moves in a small part of its path surrounded by a cloud of electrons. These electrons can be made to move with a less velocity than the alpha particle, an equal velocity and a greater velocity as desired. It was found that the electron was captured only when it possessed definite energy. This energy which was obtained from applied field was closely equal to the value of the energy level in which the electron was captured. A second experimental tube was constructed in which the alpha particles could be in contact with electrons for only 3×10^{-10} sec. The electron density was less than 10^7 per cc. The average distance from electron to alpha particle was many times too great for it to fall to nucleus in 3×10^{-10} sec. under action of central forces. It is concluded that the electron or the alpha particle or both may possibly occupy a large region of space at certain energy relations but are exceedingly small at all other energies. The per cent. of captures increased rapidly with electron density up to 90 per cent. The second experimental tube permitted investigation as to whether one electron or two electrons are captured. It was found that at $V_o = 590$ volts when the electrons and alpha particles are moving with equal velocity two electrons were captured. Also a whole series of voltages V_n was found at which double capture occurs. The condition is that two electrons together shall have an energy equal to that of removing two electrons from the helium atom. As an illustration, the work required to remove both electrons from helium atoms is $54.16 + 24.5 = 78.6$ electron volts. If the electric field V_n applied is such that the relative energy with respect to alpha particle of two electrons is 78.6 volts then double capture occurs, that is, $\frac{1}{2}(78) = 39 = (V_o^{\frac{1}{2}} - V_n^{\frac{1}{2}})^2$.

(*To be continued*)

BOOKS RECEIVED

BAKER, FRANK COLLINS. *The Fresh Water Mollusca of Wisconsin.* Bulletin 70. Part I. Gastropoda. Pp. xx + 507. 28 plates. Part II. Pelecypoda. Pp. vi + 495. 77 plates. University of Wisconsin.

BERNSTED, H. J., W. BULLOCH, L. DUDGEON, A. D. GARDNER, E. D. W. GREIG, D. HARVEY, W. F. HARVEY, T. J. MACKIE, R. A. O'BRIEN, H. M. PERRY, M. SCHÜTZE, P. BRUCE WHITE and W. J. WILSON. *A System of Bacteriology in Relation to Medicine.* Vol. IV. Pp. 482. Medical Research Council. His Majesty's Stationery Office, London. £1, 1s.

BURGESS, ERNEST W., Editor. *Publications of the American Sociological Society.* Vol. XXIII. The Rural Community. Pp. viii + 416. University of Chicago Press. $2.00.

CHAPMAN, FRANK M. *My Tropical Air Castle.* Pp. xv + 417. Ill. with drawings by Francis L. Jaques and photographs by the author. Appleton. $5.00.

COLLINS, A. FREDERICK. *Experimental Science.* Pp. xvi + 280. 145 figs. Appleton. $2.00.

FISHER, V. E. *An Introduction to Abnormal Psychology.* Pp. x + 512. Macmillan. $2.60.

GRIFFITH, R. O., and A. MCKEOWN. *Photo-Processes in Gaseous and Liquid Systems.* Pp. viii + 691. 52 figs. 54 tables. Longmans, Green. $8.50.

HACKH, INGO W. D. *A Chemical Dictionary.* Pp. viii + 790. 232 ills. Blakiston. $10.00.

HOLLINGWORTH, H. L. *Vocational Psychology and Character Analysis.* Pp. x + 409. Appleton. $3.00.

HOUSTOUN, R. A. *Intermediate Dynamics and Properties of Matter.* Pp. ix + 138. 139 figs. Longmans, Green. $1.25.

KÜSTER, ERNST. *Pathologie der Pflanzenzelle.* Teil I. Pathologie des Protoplasmas. Pp. viii + 200. 36 figs. Verlag von Gebrüder Borntraeger, Berlin. 15 M.

LULL, RICHARD SWANN. *Organic Evolution.* Pp. xix + 743. 265 figs. 31 plates. Macmillan. $4.50.

OSBORN, FREDERICK A. *Physics of the Home.* Pp. xiv + 397. 221 figs. McGraw-Hill. $3.00.

PATTON, WALTER SCOTT, and ALWEN M. EVANS. *Insects, Ticks, Mites and Venomous Animals of Medical and Veterinary Importance.* Part I. Medical. Pp. x + 786. 374 figs. 60 plates. Published by author, at Liverpool School of Tropical Medicine. $5.00.

RANDALL, HARRISON M., NEIL H. WILLIAMS and WALTER F. COLBY. *General College Physics.* Pp. xii + 540. 310 figs. Harper. $3.50.

SMITH, DAVID EUGENE. *A Source Book in Mathematics.* Pp. xvii + 701. McGraw-Hill. $5.00.

THOM, BURTON PETER. *Dust to Life.* Pp. xv + 409. Ill. Dutton. $5.00.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE MAKING OF A TELESCOPE MIRROR

"SLEET STORMS" at 3,000 degrees Fahrenheit, in which a layer of clear transparent quartz is coated on a base of white quartz by an oxy-hydrogen blowpipe, in much the same way that a clear layer of ice is sometimes coated on trees in a rainstorm in cold weather, may make possible the new 200-inch telescope, planned for the California Institute of Technology.

Speaking before the American Philosophical Society at Philadelphia on December 6, Dr. Elihu Thomson, director of the General Electric Company's research laboratory at Lynn, Mass., told of his researches on methods of making the huge mirror. This mirror, 200 inches, or sixteen and two thirds feet, in diameter, will be the heart of the telescope. It will be twice the diameter of the largest telescope mirror ever made before.

Unlike the ordinary small telescope, the new instrument will be a reflector, in which a disk-shaped mirror concentrates the rays of light from a distant star into a point on the photographic plate or in the eyepiece through which the astronomer looks. The final curve of the mirror must be ground very carefully, so that it will have exactly the right shape and give a sharp image.

Glass is the most popular material for telescope mirrors at present, but it has some disadvantages, according to Dr. Thomson. Changes in temperature produce a considerable change in the size of the glass. When any grinding is done, the friction heats the mirror. Then it must be allowed to cool before it can be tested, all of which consumes much time. And then, when the figure has been completed, and the telescope is in use, slight changes of temperature produce considerable changes in the image seen in the instrument. Therefore, it is not glass that we shall use, but fused silica, or quartz, melted in an electric furnace at between 1,700 degrees and 1,800 degrees Centigrade, which means more than 3,000 degrees Fahrenheit, or about the melting point of platinum, a metal difficult to melt, as is well known, and which does not melt in ordinary flames or furnaces. The method we shall use, and which we are using, in fact, on a small scale with great success, is, in general terms, one devised quite a number of years ago, and which consists in first melting a mass of good clean quartz sand in a circular mould in an electric furnace, and obtaining thereby a disc or thick slab of melted quartz sand. This is, indeed, fused quartz, but full of tiny bubbles, which tend to make it lighter, but the melted sand has all the desirable properties of the solid fused quartz itself.

Quartz has the advantage that it retains practically constant size for all ordinary temperatures. This makes a quartz mirror easier to figure and to use after completion. But the rough quartz disc, full of bubbles, will not take the smooth silver coating that reflects the light rays to a focus.

"This comparatively rough, bubble-filled mass of melted sand, which is the underlying disc, has to be provided with a surface layer, more or less thick, of clear glass-like fused quartz, or silica glass. It will have the same general properties, so far as expansion goes, and, therefore, will suit the purpose very well united to the sand backing. The first efforts were made by melting on to the fused sand backing slabs of clear quartz made in a different way, and the results were fairly successful. Fair mirrors could be made in that way, but at the suggestion of one of our skilled workers, an experiment was made of feeding into an oxy-hydrogen blowpipe flame, granulated or finely powdered crystal quartz (rock crystal) of high quality, and immediately it was found that a coating of clear quartz could thus be deposited upon any other piece of quartz. When oxygen and hydrogen are burned together in a jet, the temperature of the flame is high enough to fuse or melt silica, or quartz. By raining down through such a flame, the granulated crystal quartz is received on a surface much as ice deposits in clear layers on objects during a sleet storm."

SUN-SPOTS AND RADIO

GREAT activity on the sun, visible from the earth as a 700,000-mile row of sun-spots, has brought poor radio reception in recent weeks, but it will probably be followed by a gradual return to the good conditions of 1923, according to Dr. Harlan T. Stetson, director of the Perkins Observatory at Ohio Wesleyan University at Delaware, Ohio, in a statement made to *Science Service*. He believes the recent solar disturbance probably represents the peak of the present eleven-year sun-spot cycle. In collaboration with Dr. Greenleaf W. Pickard, radio engineer of Newton Center, Massachusetts, Dr. Stetson has been studying the relation between sun-spots and radio.

"The year 1930 should see a general decrease in solar activity, with a corresponding decrease in the ionization of the earth's atmosphere," Dr. Stetson declared. "This will favor the return of radio reception to normal conditions. During the subsidence period spasmodic outbreaks in the sun are to be expected at intervals, but with lessening intensity over the next five or six years.

"Scientists differ in their ideas as to just what happens when a broadcasted wave travels over the earth. Some believe that an ether wave is propagated which is reflected back to earth from an ionized layer of the earth's atmosphere known as the Kennelly-Heaviside layer which lies some 70 kilometers above the earth's surface. Others maintain that the electric wave is refracted rather than reflected from such a layer.

"Whatever the mechanism, the wave appears to be turned back by this ionized layer of the earth's atmosphere. Any change in the intensity or degree of this ionization or electrification of the earth's upper atmosphere would have the effect of bending the ray more abruptly or less abruptly towards the earth and would at once be noticed in the intensity of radio reception. The more rapid changes of this sort are doubtless responsible

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"For certain wave-lengths it is possible that the effect of a rising and falling ionized layer might actually be the reverse of that noted in the broadcasting zone, giving improved reception during greater solar activity and poorer reception during less solar activity. Curiously enough, this is just what has been observed by Dr. Pickard at the Newton Center Laboratory when working on long waves of 18 kilocycle frequency."

HEART-BEAT STARTED BY RADIOACTIVE POTASSIUM

THE potassium in the diet is the radioactive element which normally performs the vital function of starting the heart-beat, it appears from experiments conducted in the laboratory of Dr. H. B. Zwaardemaker, professor emeritus of physiology at the University of Utrecht. These experiments have been reported by Dr. Charles C. Lieb, professor of pharmacology at the College of Physicians and Surgeons, Columbia University, who has himself spent some time on research in Dr. Zwaardemaker's laboratory.

Earlier experiments of Dr. Zwaardemaker seem to have definitely established the fact that potassium is a radioactive element. The recent experiments have indicated that a radioactive element is essential in the initiation of the heart-beat, and therefore an indispensable element of diet.

Pursuing these studies further Dr. Lieb will investigate the pharmaceutical value of radioactive spring-waters, such as those found at Saratoga Springs, Arkansas Hot Springs, the Georgia Springs owned by Governor Roosevelt, of New York, where infantile paralysis cases are treated, and many other famous spas throughout the country. For years it has been known that the waters of these springs were radioactive, but the active charges have been so small that leading radium authorities have considered their radioactivity a negligible quantity therapeutically.

Dr. Zwaardemaker's work, Dr. Lieb pointed out, not only indicates that the radioactivity of potassium is one millionth to one-hundred millionth that of radium, but that even this minute charge is essential to the maintenance of the heart-beat.

"This may mean," said Dr. Lieb, "that even the very slight degree of radioactivity in the waters of famous spas is of distinct therapeutic value, although it is impossible for me to make any statement on the subject before extensive experimentation. Dr. Zwaardemaker discovered, however, that the radioactive elements uranium, polonium, thorium and radium may replace potassium in some of the simpler processes of cell activity.

"In just what radioactive group potassium must be placed we have not determined. Probably that is the work of a physicist. But it does seem to be established that potassium gives off beta radiation. This is distinguished from alpha and gamma radiation as being in the order of the electron. Alpha radiation consists of helium atom nuclei, while gamma radiation is hard like X-rays.

"It is apparently the electrons from potassium atoms and their ionizing power that furnish the energy necessary in initiating the heart-beat, but we are not yet prepared to discuss the mechanics of the process."

Dr. Lieb explained that the experiments consisted of the perfusion of the hearts of eels and frogs. When the hearts of these animals are taken out canulae, or small glass tubes, are attached to the blood vessels and fluid is passed through the hearts. The fluid does not contain potassium or other radioactive elements at first, and the heart ceases to beat in half an hour to an hour.

Potassium is then introduced into the liquid and the heart resumes its beat and continues to beat for about twenty-four hours. Similar results are obtained when instead of potassium another radioactive element is used. Not only did this physiological action lead to the conclusion that potassium was radioactive, but measurements on specially constructed electrometers indicated that it gave off beta radiation.

SEX HORMONES

THE important sex hormone has just been obtained in pure form for the first time by a German scientist, Dr. M. Butenandt, working at the laboratory of a recent Nobel Prize winner, Professor Adolf Windaus, at the University of Göttingen.

This hormone, which has been known to the medical profession for some years, is thought to be capable of restoring the functioning of the reproductive organs. Heretofore it has been obtained only in combination with other compounds, but Dr. Butenandt has been able to produce the hormone itself in pure form, as a crystalline substance which he has named progynon.

The sexual hormone is one of a number of curious and as yet little understood substances which are secreted by the ductless glands of the human body. Each of these special chemicals is responsible for the proper functioning of certain bodily activities, and physiological chemists believe that a systematic study of these secretions will lead not only to an understanding of the physical operations of the body, but even to an explanation of mental characteristics and that elusive property called "character."

The importance of obtaining a hormone in a pure state is that it is the first step toward the determination of its

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An Announcement:

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structure and its synthetic production in the laboratory. The action of the hormones within the body and their influence on other chemical processes of the body may be better understood after the structure of the hormones has been determined.

Progynon belongs chemically to the group of stearates, or fats, and it is related to the artificial vitamin, vigantol, discovered by Professor Windaus. This also puts it in the same class as the poison of toads and the bile acids. On the other hand, adrenalin, the hormone of the suprarenal glands, is related chemically to the plant drugs known as the alkaloids, of which morphine is a well-known example. Adrenalin was the first hormone isolated in a pure state, and it has since been produced synthetically.

ELECTROSURGERY IN TREATING CANCER

THAT new and novel adjunct to the surgeon's knife, electrosurgery, finds its greatest usefulness in the treatment of cancer, Dr. Howard A. Kelly, emeritus professor of gynecology and obstetrics in the Johns Hopkins University, told members of the Southern Surgical Association at their meeting in Atlanta on December 10.

This new method is not to be mistaken for merely a more convenient form of cautery, but is a specialty which must be learned with painstaking care, Dr. Kelly emphasized. He urged that the new procedure be given more attention in the big hospitals of the country, and that the younger generation of surgeons be given opportunities to test it out.

One very important advantage of electrosurgery is that it controls hemorrhage easily without the need of tying off each vein and artery, which must be done at each step of other surgical operations.

"In deep operations by older methods the surgeon often loses precious minutes in his efforts to check a severe hemorrhage and feels as well estopped from going further in that direction. With electrosurgery the lymphatics and smaller blood vessels are sealed with the progress of the operation.

"It sterilizes the parts attacked, destroying all bacteria and septic tissues as well as the malignant cells to which the growth owes its specific character and continuance. There is further no handling and squeezing of the tissues, a great boon in any aggressive treatment of malignancy, avoiding the further distribution of the cells.

"One might also well call it a knife and fork operation as the handling of the parts is limited to the slight sterilizing touch of the simple instruments used, avoiding even the gloved fingers of the surgeon.

"An immense advantage lies in the greatly enhanced facility in operating in areas awkward or difficult of access as in the nose and throat."

Dr. Kelly described the method in some detail and added that it is even valuable, in some types of cases, when radium can not be used any longer.

ITEMS

A METHOD of removing a diseased organ by chemical rather than surgical means was described by Dr. Charles H. Mayo, of Rochester, Minn., at the Atlanta meeting of the Southern Surgical Association. The technical term for the operation is "chemical hysterectomy." The procedure is particularly valuable in cases when the usual surgical methods of hysterectomy would be too dangerous to undertake because of the presence of serious disease in the heart or kidneys as well as in the organ to be removed. In the method followed by Dr. Mayo zinc chloride is the chemical used. He has used the procedure in 26 cases in which it was unsafe to operate by one of the usual procedures. He believes that, in its limited field, the method is of value.

LEAVES millions of years old which still hold all the colors of autumn have recently been found in the newly discovered fossil leaf beds of Wheeler County, central Oregon, by Dr. Ralph W. Chaney, paleobotanist of the Carnegie Institution of Washington. The perfect preservation of the coloring in the leaf impressions is attributed to minerals in the matrix. Dr. Chaney found in volcanic shale an intact leaf, bearing virtually the appearance it did when it fell from a jungle tree millions of years ago. This leaf was sealed in its matrix and will be sent to the University of California at Berkeley. The plant horizon is just above the beds of the Cretaceous seas which swept over ancient Oregon, leaving an abundance of marine fossils in the Mitchell area.

ALONG the Susquehanna River have been found village sites once occupied by the Conestoga Indians. Eighty-nine complete pottery vessels and many other every-day possessions of this extinct tribe have been unearthed by G. B. Fenstermacher, of Lancaster, in cooperation with the State Museum at Harrisburg. Captain John Smith, who first encountered the Conestoga in 1608, described them as being warlike and far superior in physique to other neighboring tribes. Yet they were conquered by the Iroquois Indians in 1675, and less than a hundred years later the twenty warriors that were the only remnants of the once powerful tribe were massacred by white men, at Lancaster, Pa. Growing interest in Pennsylvania's prehistory has lately aroused the state legislature to appropriate $20,000 to the Historical Commission for the purpose of conducting researches within the state.

AFRICAN crocodiles can harbor a form of sleeping sickness from the tsetse fly, but this is not the human type. The crocodile gets the disease by sleeping with his mouth open, thus permitting the flies to walk around and bite the soft membranes exposed. The disease is not transferred in the bite, but may be transferred if the beast wakes up irritated and snaps at the flies, thus crushing them and swallowing the parasites or germs carrying the disease. This particular germ requires the crocodile and the fly to complete its life cycle just as a malarial parasite requires man and the mosquito. These facts were determined by Cecil A. Hoare, of the Wellcome Bureau of Scientific Research, in a study on crocodiles made at the Human Trypanosomiasis Research Institute at Entebbe, Uganda.

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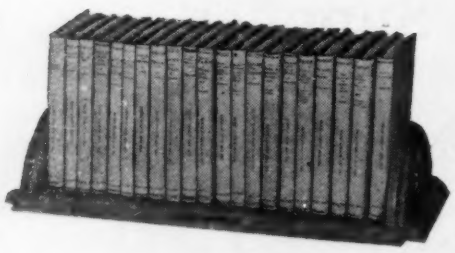

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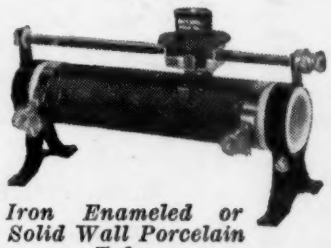

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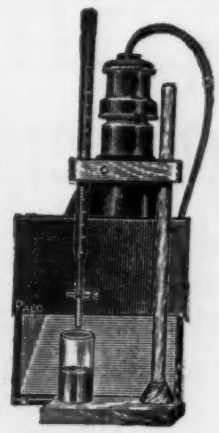

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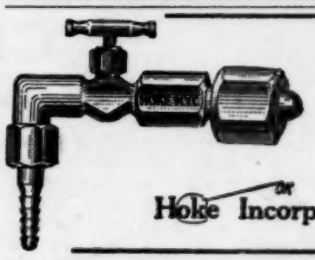

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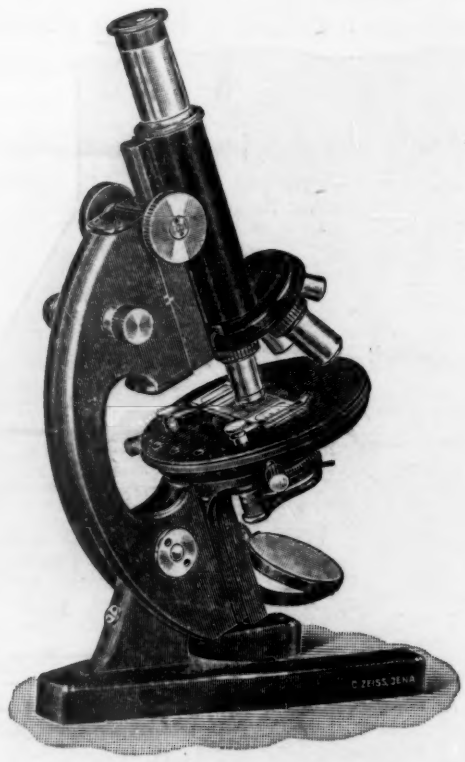

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